Frontline Sirius®

Advanced Anaesthesia Systems

First Line and Planned Maintenance Manual

Sirius 3000
Sirius 2000
Sirius 1000

Blease
An CSI Systems Company

Blease

Frontline Sirius

Anaesthetic Machines

First Line
and
Planned Maintenance Manual

MODIFICATIONS LABEL				
ECN 1 4676	ECN 2	ECN 3	ECN 4	ECN 5
ECN 6	ECN 7	ECN 8	ECN 9	ECN 10

CE 0120

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Important

Read this manual *before* operating or servicing the machine.

Read the vaporizer manual *before* operating the machine.

For all users and Service Personnel, refer to the User Manual *before* operating the machine.

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Product Improvement

Blease Medical Equipment Limited has a policy of continued product improvement and therefore reserves the right to make changes which may affect the information contained in the manual without giving prior notice.

Responsibilities of the Manufacturer

The manufacturer accepts responsibility for the effects on safety, reliability and performance of the equipment only if:

- assembly operations, extensions, adjustments, modifications and repairs are carried out by persons with written authorisation from the manufacturer;
- the equipment is used in accordance with the instructions for use;
- the electrical installation of the relevant room complies with the 'Regulations for the Electrical Equipment of Buildings'.

NB
If during the warranty period the equipment is serviced by an unauthorised party, the warranty will be void.

Disclaimer

Opening of the control unit by unauthorised personnel automatically voids all warranties and specifications. The prevention of tampering is solely the user's responsibility; the manufacturer assumes no liability for any malfunction or failure of the ventilator if the control unit is opened.

The instructions in this manual assume that the engineer is familiar with and has had training in the servicing and care of anaesthetic equipment and is able to use pressure gauges, flowmeters and other laboratory equipment.

Blease accept no responsibility or liability for any patient injury or adverse circumstances which may arise from unauthorised maintenance of Blease Frontline Sirius Machines.

Note to Service Personnel

The Frontline Sirius® and integrated equipment must only be serviced by Qualified Service personnel.

The contents of this manual are not binding. If any significant difference is found between the product and this manual please contact Blease Medical Equipment Limited for further information.

To ensure correct functioning, the equipment must be serviced at regular intervals.

Blease Medical Equipment Limited recommends that the machine should be serviced at intervals not exceeding six months. Qualified Service Personnel and genuine spare parts should be used for all servicing and repairs. Blease Medical Equipment Limited will not otherwise assume responsibility for the materials used, the work performed or any possible consequences of the same.

In communication with Blease Medical Equipment Limited, quote the model and serial number of the equipment, with the approximate date of purchase. If the equipment is being returned for repair, indicate the nature of the fault or the work you require to be carried out.

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Symbols and Abbreviations

APL	Airway Pressure Limiting
bpm BPM	Breaths per minute
cmH_2O	Gauge pressure expressed in centimetres of water
CPAP	Continuous positive airway pressure
PEEP	Positive end expiratory pressure
I:E Ratio	A ratio of inspiratory to expiratory time
	IEC symbol to consult the instructions for use
	IEC symbol denoting type of equipment (B)
	WARNING: There is danger of personal injury to the user or patient
	Further relevant or helpful information
	Turning the control in the direction of the thickening line, an increase in that parameter is produced
	Power off
	Power on
	Dangerous voltage
l/m lpm	Litres per minute
ml	Millilitres
O_2	Oxygen
psi	Pounds per square inch
psig	Pounds per square inch gauge
l	Litres
	IEC symbol for alternating current
	Confers approval under theEuropean Medical Device Directive
	End of Case
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

Hazard Notices

This handbook contains important hazard information. You must read this hazard information before using the Frontline Sirius®.

Warning Notices

Warning notices denote a potential hazard to the health and safety of users and/or patients. These notices clearly state the nature of the respective hazard and the means by which it can be avoided.

Warning notices appear in full in the preliminary pages and are repeated at their points of application in the manual.

Caution Notices

Cautionary notices denote a potential hazard to the physical integrity of equipment/software but NOT a danger to personnel. These notices clearly state the nature of the hazard and the means by which it can be avoided.

Cautionary notices appear in full in the preliminary pages and are repeated at their points of application in the manual.

Relevant or helpful Information

Warnings

The following statements are made to comply with the requirements of IEC 60601-1.

1. This equipment must only be connected to gas pipeline supply lines that are fitted with pressure relief valves that limit the supply pressure to less than 7 bar.
2. The functioning of this machine may be adversely affected by the operation of equipment such as high frequency surgical (diathermy) equipment, defibrillators or shortwave therapy equipment in the vicinity. Increasing the distance from such equipment will minimise any possible interference.
3. Prior to connecting the machine to a patient carry out the pre-use check to verify correct alarm operation. To verify the O2 alarm, set the flowmeters to give a concentration of 50% oxygen. Using the controls on the oxygen monitor panel, set the low oxygen level to 60% and verify the oxygen low alarm operates. Set the high oxygen alarm level to 40% and verify that the oxygen high alarm operates.
4. The oxygen flow can only be reduced to zero by turning the ON/OFF switch to the OFF position. Excessive force on the oxygen control knob may damage the hypoxic guard.
5. To avoid explosion hazards, flammable anaesthetic agents such as ether and cyclopropane must not be used in these machines. Only anaesthetic agents which comply with the requirements on non-flammable anaesthetic agents in IEC 60601-2-13 'Specification for Anaesthetic Machines', are suitable for use in these machines.
6. As these machines are not suitable for use with flammable anaesthetic agents such as ether and cyclopropane the use of antistatic breathing tubes and face masks is not necessary.

   The use of antistatic or electrically conductive breathing tubes when utilising high frequency surgery equipment may cause burns and is therefore not recommended in any application that involves such apparatus.
7. The equipment must be periodically checked and maintained to ensure proper operation.
8. Performance of the equipment may be affected at temperatures below 10°C (50°F) and above 40°C (104°F).
9. The performance of the anaesthetic machines and vaporizers may be degraded if the two are mismatched. Refer to the vaporizer manufacturer's instruction manual before use.
10. If the integrated oxygen analyser is not fitted, an oxygen analyser complying with ISO 7767 shall be used when the anaesthetic machine is in use.
11. The units use semiconductor devices which are susceptible to damage by overloading, reversed polarity, electrostatic discharge and excessive heat or radiation. Avoid hazards such as reversal of batteries, prolonged soldering, strong RF fields or other forms of radiation, use of insulation testers or accidentally applied short circuits. Even the leakage current from an unearthed soldering iron may cause trouble.

Electrostatic Sensitive Devices (ESD)

Warnings and Cautions

All ESD must be stored in approved conductive packaging, tubes, shipping bags, foam or tote bins.

All persons handling ESD must be properly grounded via a 1MW resistive grounded wrist strap.

Cover all ESD bench tops with grounded conductive mats and connect all work surfaces and equipment to earth ground.

Transport all assemblies containing ESD in a conductive bag or container.

DO NOT use cellophane adhesive tape to wrap DIP (dual in-line package) tubes together.

DO NOT handle ESD by their pins or mix them with other routine electronic parts.

Never place ESD on ungrounded surfaces or leave them unattended in an open area.

Avoid cellophane wrappers, synthetic (non-conductive) carpeting, warm or cool air blasts, Styrofoam coffee cups, etc when working with ESD.

Use only properly designed heat lamps, heat chambers and/or 'antistatic' quick-chill sprays during troubleshooting or stress testing procedures.

NB
In particular electronic assemblies in the Frontline Sirius® range of machines are easily damaged by ESD and require special handling.

Cautions

Anaesthetic Machines

Do not leave gas cylinder valves open if the pipeline supply is in use and the system master switch is turned ON. Pressures from both supplies may become equal and, if simultaneously used, cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

The hypoxic guard control system only ensures that oxygen-nitrous mixtures will have a minimum oxygen concentration. HYPOXIC MIXTURES MAY BE DELIVERED IF GASES OTHER THAN OXYGEN, NITROUS OXIDE OR AIR ARE USED, OR WHEN OPERATING AT LOW OXYGEN FLOW RATES. When using carbon dioxide, as an additional gas, make sure the proportions of all gases are carefully adjusted in accordance with accepted clinical practice. Gas mixtures within the breathing system must be monitored when using these gases.

Leaking gases and vapours (downstream of the flow control valves and Oxygen Flush valve) may deprive the patient of metabolic gases and anaesthetic agent may pollute the atmosphere. Tests that detect leaks must be performed frequently. If detected, leakage must be reduced to an acceptable level.

Do not use the anaesthesia system if the hypoxic guard control system does not operate within permitted ranges. Using an incorrectly operating control system may result in incorrect gas mixtures and injury to the patient.

When occluding the breathing system for test purposes, do not use any object small enough to slip completely into the system. Objects in the breathing system can interrupt or disrupt the delivery of breathing system gases, possibly resulting in injury to the patient. Before using the breathing system on a patient, always check the breathing system components for foreign objects.

Do not place materials weighing more than 25kg on the bottom shelf, or more than 25kg on the upper monitor shelf. Overloading may cause damage to the shelves or cause instability.

Secure any equipment placed on the shelves.

To avoid stripping threads, do not use tools on the yoke gate T screws. Use only one cylinder gasket per yoke. Using more than one gasket could cause cylinder gas leakage.

Ventilator

The volume sensor must be correctly installed at either the distal location in the patient system's expiratory limb or the proximal end of the Y connector. If the sensor is installed incorrectly, volume data will be inaccurate and associated alarms, including the low minute volume alarm will not function properly.

Position the volume sensor's cable with care. If the cable is pinched or cut, the ventilator's volume monitoring may not function correctly.

Do not connect the ventilator or absorber exhaust directly to a vacuum source. The vacuum may remove required gases from the breathing system. (Only applies to Frontline Sirius 1000® and 2000®).

Ventilator inoperative messages indicate that a problem exists in the ventilator. Do not attempt to use the ventilator while a ventilator message is displayed.

Do not attempt to use the ventilator if the alarm mute button will not silence alarms.

WARNING: If an alarm condition cannot be resolved, do not continue to use the system.

Sterilise the bellows assembly periodically to minimise the risk of cross infecting patients. Use a sterilization schedule that complies with your institution's infection control and risk management policy. Only use Blease approved sterilization methods. As mentioned in section 4.

If any foreign materials or liquids are trapped in the driving gas circuit, or the pop off valve or the bellows base they could impair the valve's operation. Do not use the bellows assembly if

you suspect that materials are trapped. Have the assembly repaired by trained service personnel.

Perform the Pre-Use Check procedures after cleaning and sterilizing the bellows.

Always perform the Pre-Use Check procedures for volume sensing functions after cleaning or replacing the volume sensor.

Vaporizer

Do not use any vaporizer that is visibly misaligned on the manifold or that, when it is locked, can be lifted off the manifold. Incorrect mounting may result in incorrect delivery of gases.

A vaporizer is calibrated and labelled for one agent only. Do not fill with anything other than the designated agent.

If a vaporizer is filled with the wrong agent, draining will not eliminate the agent, because the wick will have absorbed some of the agent. The wick must be thoroughly cleaned and dried by trained service personnel.

The vaporizers must be completely upright for the sight glass to properly indicate agent levels.

Never oil or grease any oxygen equipment unless the lubricant used is made and approved for this type of service. In general, oils and greases oxidise readily, and - in the presence of oxygen - will burn violently. Fomblin is the recommended oxygen service lubricant (stock number ST7014).

After performing any maintenance or repair procedure, always verify proper operation of the system before returning to use.

Use cleaning solution sparingly. Do not saturate system components. Excessive solution can damage internal devices.

Following ethylene oxide sterilization, quarantine the equipment in a well ventilated area to allow dissipation of absorbed ethylene oxide gas. In some cases, aeration periods of seven days or more may be required. Aeration time can be decreased when special aeration devices are used. Follow the sterilizer manufacturer's recommendations for aeration periods required.

Notes

1.0 Technical Description

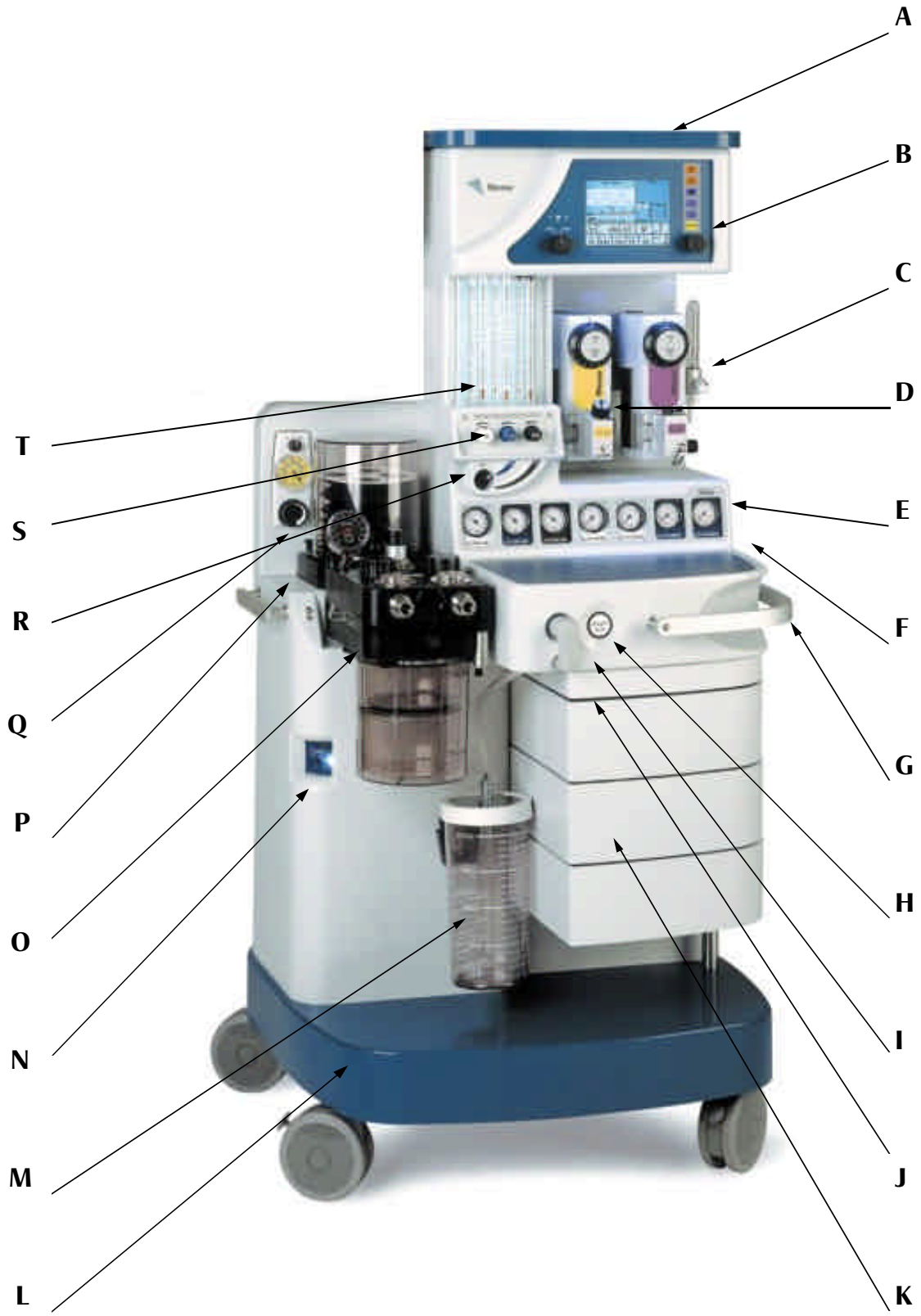


Figure 1 Frontline Sirius® 3000

Key to Figure 1

A Monitor shelf
B Ventilator
C Independent O_2 Flowmeter (only on the 3000 model)
D Vaporizer
E Cylinder/Pipeline Gauges
F Pneumatic Unit - (behind gauge panel)
G Handle
H Oxygen Flush
I Common Gas Outlet
J Writing Table
K Drawer
L Frame
M Suction Receiver Jar
N Anaesthetic Gas Scavenging System (AGSS)
O Absorber
P Bellows
Q Suction Controller
R Main On/Off or Off, N_2O/Air Interlock Switch
S Flow Control Valves with Hypoxic Guard
T Flowblock Assembly

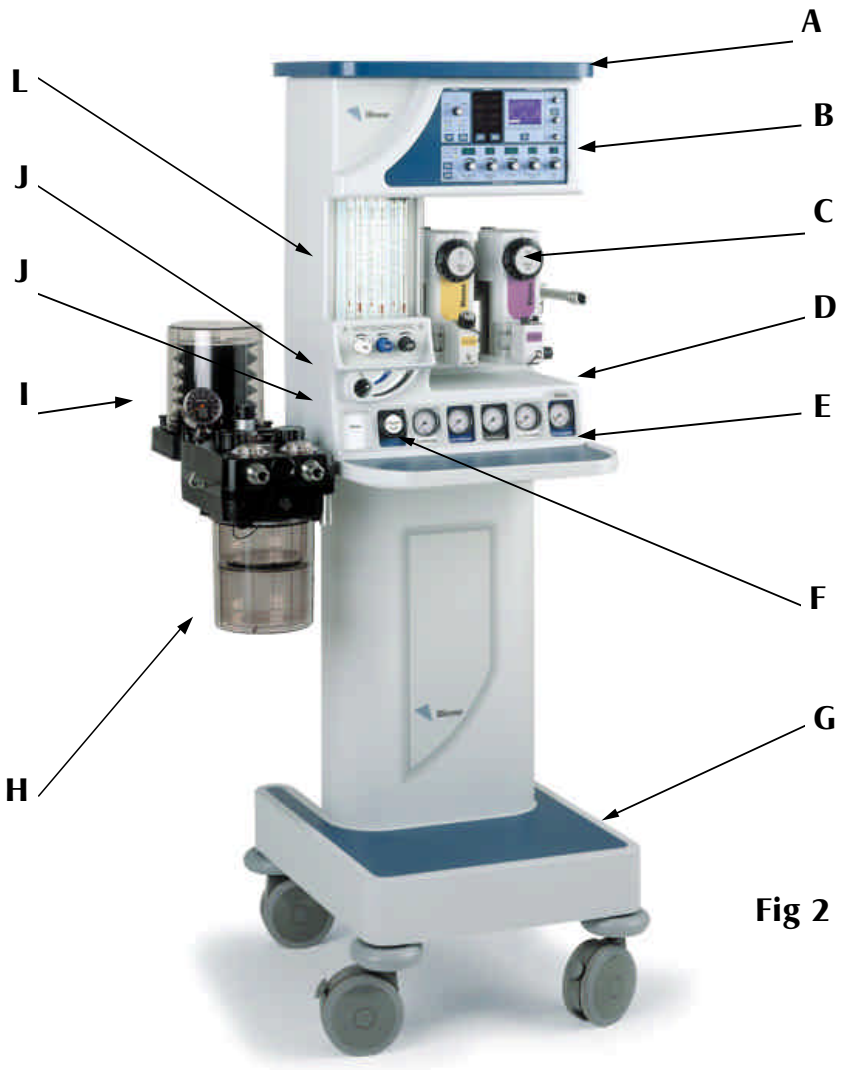
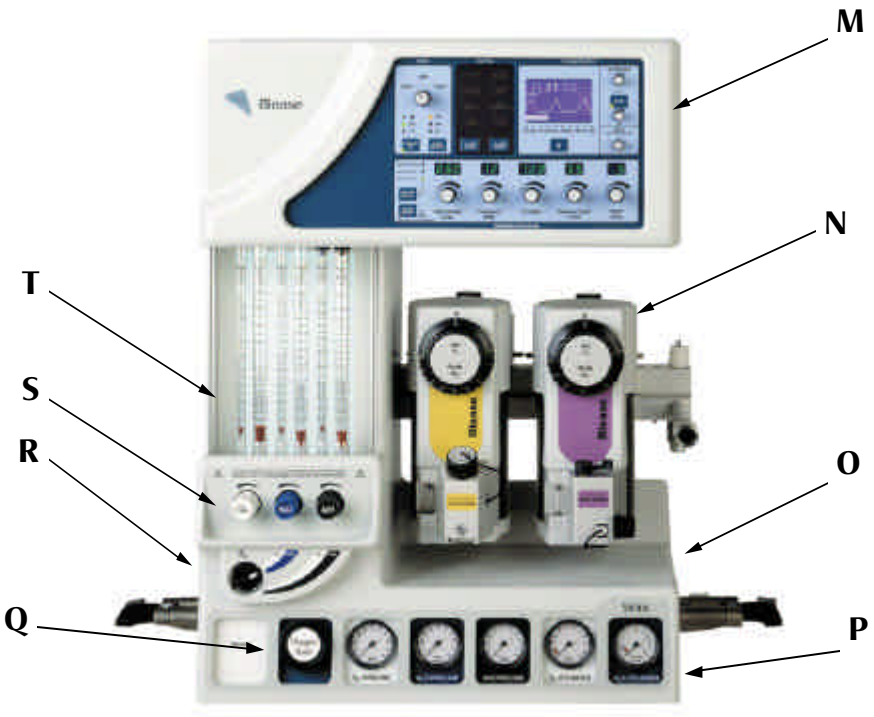


Fig 2 Sirius 2000 & Sirius 1000



Key to Figure 2

Sirius 2000

A Monitor shelf

B Ventilator

C Vaporizer

D Cylinder/Pipeline Gauges

E Pneumatic Unit - (behind gauge panel)

F Oxygen Flush

G Frame

H Absorber

I Bellows

J Main On/Off or Off, N2O/Air Interlock Switch

K Flow Control Valves with Hypoxic Guard

L Flowblock Assembly

Sirius 1000

M Ventilator

N Vaporizer

O Cylinder/Pipeline Gauges

P Pneumatic Unit

Q Oxygen Flush

R Main On/Off or Off, N2O/Air Interlock Switch

S Flow Control Valves with Hypoxic Guard

T Flowblock Assembly

1 Technical Description

1.1 Description

1.1.1 General

The Frontline Sirius® anaesthetic machine contains all the pneumatic circuitry, controls, monitoring, ancillaries and storage required to control, distribute and mix medical gases and anaesthetic agents in order to deliver them to a patient system.

The Frontline Sirius® anaesthetic machine is based on the Frontline machines. The Sirius has enhanced components and new features and improvements.

The Frontline Sirius® Anaesthetic machine is designed to comply with ISO 5358, IEC 60601-1, IEC 60601-2-13 and BS EN 740.

Referring to Figure 1, the Frontline Sirius® machine consists of the major sections shown.

WARNING: There may be some differences between the specifications in this manual and those for USA-specification Frontline Sirius® machines.

1.1.2 Pneumatic Assembly

The frame contains the pneumatic assembly. The pneumatic unit contains the gas supply inputs, the pneumatics that regulate the supply pressures to a usable pressure, the oxygen failure alarm and its logic circuitry, the common gas outlet, the user controls and the pneumatic power outlets. Above the work surface are the cylinder contents and pipeline pressure gauges, flow control valves, hypoxic guard and flowblock assemblies, the vaporizer support rail and the uprights which support the monitor shelf.

WARNING: In order to minimise the possibility of running the oxygen supply cylinders down it is recommended that the machine be switched off when it is not in use.

1.1.3 The Frame

The frame is made of steel supported on four castors, the front two of which have brakes. The steel frame is covered by mouldings with a painted finish.

1.1.4 The Monitor Shelf

The monitor shelf A in Figure 1, is mounted on top of the machine. Loading should not exceed 25Kg.

1.1.5 AGSS

The AGSS is integrated with the Frontline Sirius 3000 but external on the Frontline Sirius 2000 and 1000. An external flap marked AGSS is provided on the Frontline Sirius 3000 for connection of other breathing circuits.

1.1.6 Suction

The suction controller is integrated into the Frontline Sirius 3000 and can be fitted externally to the Frontline Sirius 2000 and 1000. On the 3000 the filter is beneath the work surface and provision for the receiver jar is below the work surface. The controller has an OFF position, a max position and an adjustable setting.

1.1.7 Absorber

The absorber is integrated on the Frontline Sirius 3000 and attached to the side of the 2000. It can be rail mounted with the 1000.

1.1.8 Ventilator

Either the 8700 ventilator or 6700 ventilator fitted to the 3000, these have CMV, PCV and SIMV. Comliance Compensation and Fresh Gas Compensation. The 8700 has spirometry loops.

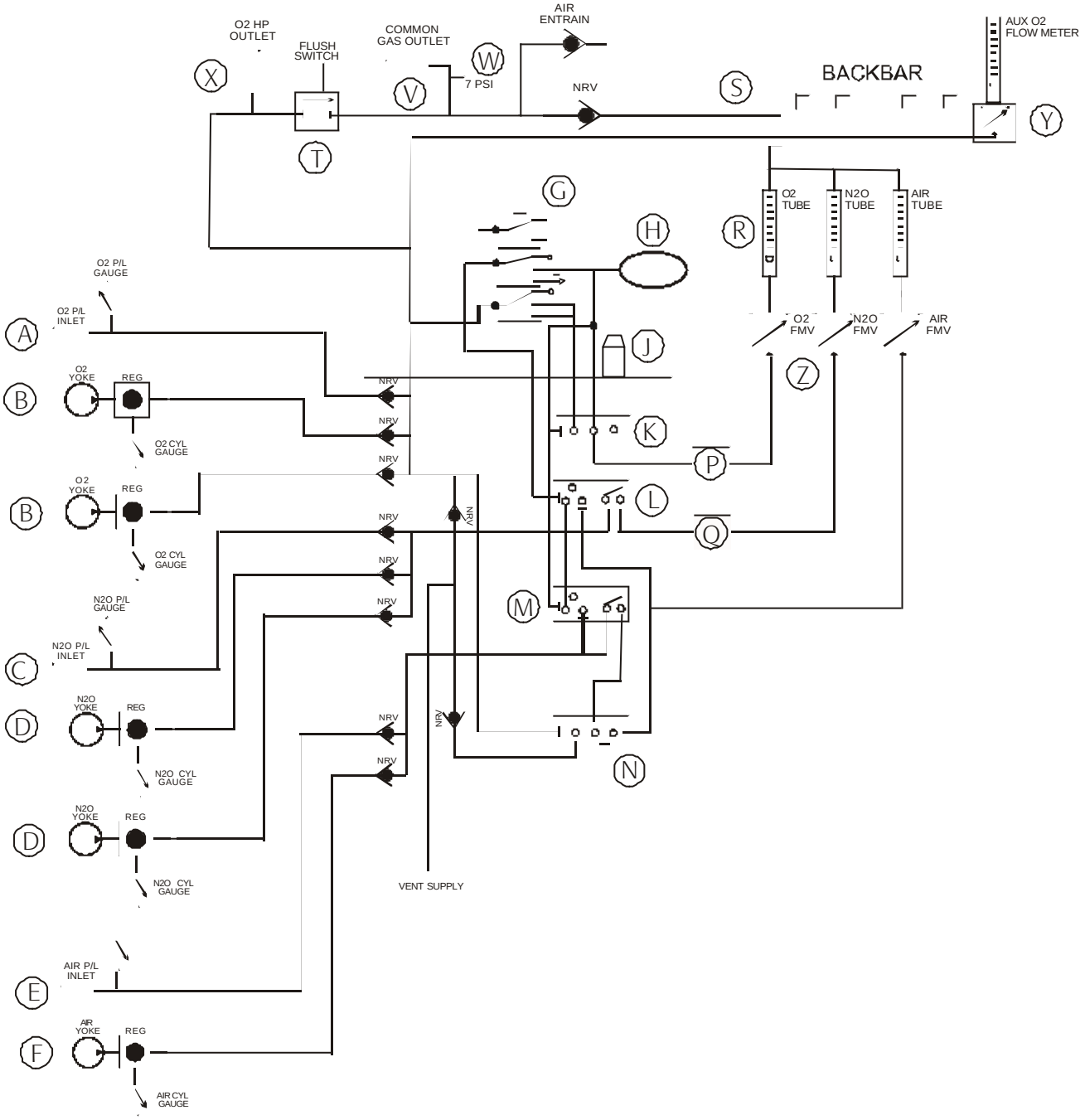


Figure 3 Pneumatic Circuit (Manifolded)

Key to Figure 3 Pneumatic Circuit (Manifolded)

A O_2 Pipeline

B O_2 Cylinder Yoke

C N_2O Pipeline

D N_2O Cylinder Yoke

E Air Pipeline

F Air Cylinder Yoke

G ON/OFF– N_2O/AIR Switch

H Reservoir

J Oxygen Failure Alarm

K O_2 SHUT OFF Valve

L N_2O/AIR Interlock Valve

M Air Valve

N Air Take Over Valve

P O_2 Secondary Regulator

Q N_2O Secondary Regulator

R Flow Meters

S Backbar

T O_2 Flush

V Common Gas Outlet

W Blow off Valve

X O_2 HP Outlet

Y Aux Flow Meter

X Hypoxic Link System

Notes

1.2 Specification

1.2.1 Machine Dimension

Model	Height	Max. Width	Depth	Average Weight
1000	605mm	690mm	245mm	30kg
2000	1486mm	505mm	615mm	68kg
3000	1486mm	747mm	705mm	110kg

1.2.2 Work Surface Dimensions

Model	Height	Area	Monitor
1000	N/a	N/a	N/a
2000	854mm	76000mm_2	175,833mm_2
3000	854mm	98612.2mm_2	175,833mm_2

1.2.3 Maximum Loading

Model	Monitor Shelf	Work Surface	Low Shelf
1000	N/a	N/a	N/a
2000	25kg	25kg	25kg
3000	25kg	25kg	25kg

All loadings to be evenly distributed.

1.3 Pneumatics

1.3.1 Gas-Specific Colour Specifications

Gas	UK	USA
Oxygen	White	Green
Nitrous Oxide	Blue	Blue
Air	Black	Yellow

1.3.2 Electrical Cable Colour Specifications

Cable	Colour (UK)	Colour (USA)
Neutral	Blue	White
Live	Brown	Black
Earth	Yellow/Green	Green

1.3.3 Gases

	3000	2000	1000
Max No. of Gases	3	3	3
Max No. of Cylinders	4	3	2
Max No. of Pipelines	3	3	3
Max No. of Gauges	7	5	5
Max Cylinder Size	E	E	E

1.3.4 Common Gas Outlet

The common gas outlet is fitted onto the front of the machine below the work surface. It will accept a 22mm female or 15mm male taper coupling.

1.3.5 Technical/Performance Specification

1.3.5.1 Controls

Oxygen flow	150 ml/m to 10 l/m Simplex/ Cascade
Nitrous oxide flow	0 ml/m to 12 l/m Simplex/Cascade
Air flow	0 ml/m to 15 l/m
Flowblock assembly accuracy	+ 5% measured value at 20°C and 101.3KPa
Oxygen flush	Non-locking 45 to 50 l/m
Vaporizers	Accepts Selectatec
Hypoxic gases	Minimum 21% oxygen/nitrous oxide

1.3.5.2 Ventilator

An optional built-in ventilator is available, either the 6700 or 8700. Refer to the appropriate user manual for details.

1.3.5.3 Alarms / Indicators

Oxygen failure	Audible alarm for minimum of 8 secs when oxygen pressure falls below 2.25 bar (225 KPa)

1.3.5.4 Regulator Safety Valve Settings

Cylinder	3.6 Bar
Cylinder regulator relief valve	5 Bar
Machine gas piping design rating	7 Bar/max.
Secondary hypoxic regulators	25-32 O_2 } 0.5Lpm flow 25-35 N_2O
Common gas outlet relief valve	6.5 - 7 psi

1.3.5.5 Supplies

O_2, air, N_2O pipeline	4 bar (400 KPa)
Optional pipeline	7 bar (700 KPa) BS 5682 Medical Grade Air
Auxiliary pneumatic outlets	Air or O_2 - 4 bar at zero flow. 80 l/m max. flow

1.3.5.6 Environmental

Temperature:	
Operation	5°C to 40°C (41°F to 104°F) oxygen cell operates to specification 10°C-40°C (50°F-104°F)
Storage:	-20°C to 60°C (-4°F to 140°F) with oxygen cell removed 0°C to 50°C (32°F to 122°F) with oxygen cell in place
Humidity	15-95% Non-condensing

2.0 User Pre Use Tests

Pre Use Check

2.1 Pre Use Check

Switch the machine off.

2.2 Cylinder and Pipeline Supplies

1. Check that all the cylinders are securely and correctly mounted in their yokes.
2. Disconnect all the pipeline supplies and turn off all the gas cylinders.
3. Turn on each cylinder in turn and check that its contents gauge registers an adequate supply of gas.
4. Turn off each cylinder in turn and check that there is no observable movement of the pointer over one minute.
5. Reconnect the pipeline supplies and check that their respective pressure gauges show the hospital pipeline pressure.

2.3 Flowblock Assemblies

1. Turn all the flow control knobs fully clockwise and check that no gas flows show on the flowblock assemblies.
2. Switch the machine on.
3. Check that:

   No gas flows are registered on any of the flowblock except for the oxygen flowblock assembly which should register flow of 130 to 170 ml/m.
4. Adjust the flow of all gases through their full range and check for erratic float movement.

2.4 Oxygen Failure Warning System Check

1. Shut off the oxygen cylinders and pipeline. Leave other gas supplies on and the flow control set to deliver > 1 l/m.
2. Check that:
   a) as the remaining oxygen is depleted, the oxygen failure warning whistle is activated for at least 8 seconds;
   b) the gas flows through the flowblock assemblies are all cut off with the exception of Air.

3. Restore the oxygen supply and check that the gas flows through the flowblock assemblies are restored.
4. Turn the nitrous oxide flow control counter-clockwise until a flow of 10 l/m is indicated on the nitrous oxide flowblock assembly. Check that the indicated flow through the oxygen flowblock assembly is 3 to 4 l/m.
5. Turn the oxygen flow control clockwise until a flow of 1.5 l/m is indicated.
6. Check that the nitrous oxide flowblock assembly is indicating 3.8 to 5.2 l/m.

2.5 Leak Test -Vaporizers

1. Check that each vaporizer for the required volatile agents is fitted correctly to the machine, that any backbar locking mechanism is fully engaged and that the control knob(s) rotate through their full range. Turn off the vaporizer.
2. When charging each vaporizer, ensure that the correct anaesthetic agent is used and that the filling port is tightly closed.
4. Set a suitable flow of oxygen (6 to 8 l/m), turn the vaporizer off and temporarily occlude the common gas outlet. There should be no leak from any of the vaporizer fitments and the oxygen flowtube float will dip.
5. Repeat this test with each vaporizer turned on. There should be no liquid leak from the filling port.
6. Turn off each vaporizer and the oxygen flowblock assembly control knob.

2.6 Ventilator

1. Check screen/display and mains power LED are illuminated.
2. Check that the patient flow sensor and tubing are connected and in good condition.

2.7 Absorber Pre-Use Check

WARNING: Do not use a faulty absorber - injury to the patient may result. Call an authorised service engineer or return the unit to the supplier.

1. Carry out a careful visual inspection of the absorber.
2. Ensure the absorbent canisters are full and installed. Ensure that all canister seals are present and are correctly installed. (See Fig. 5).
3. Undo the two valve covers and check that both the inspiratory and expiratory valve discs are clean and free to operate. Check the valve seats for chips, damage, etc. Replace the discs and covers.
4. Ensure that the bypass control is in the ABSORBER ON position.
5. Ensure that the oxygen sensor port either has a sensor fitted or that the blanking plug is fitted.
6. Ensure all tubing is correctly and securely installed.

Figure 4 Attaching Absorber Tubing

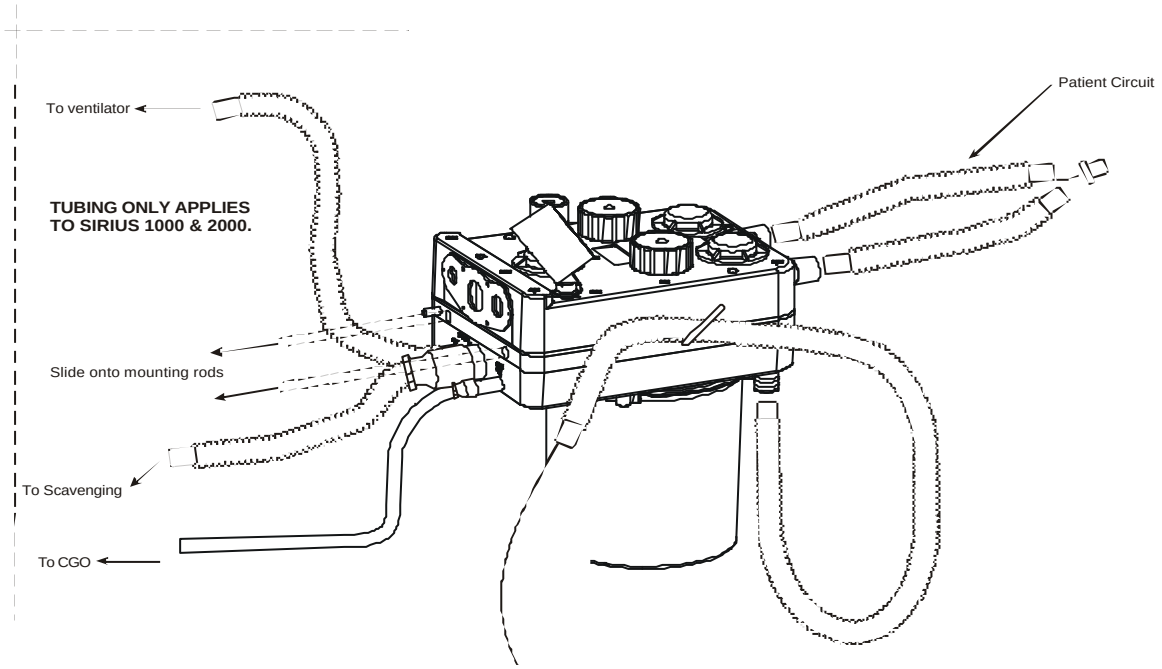
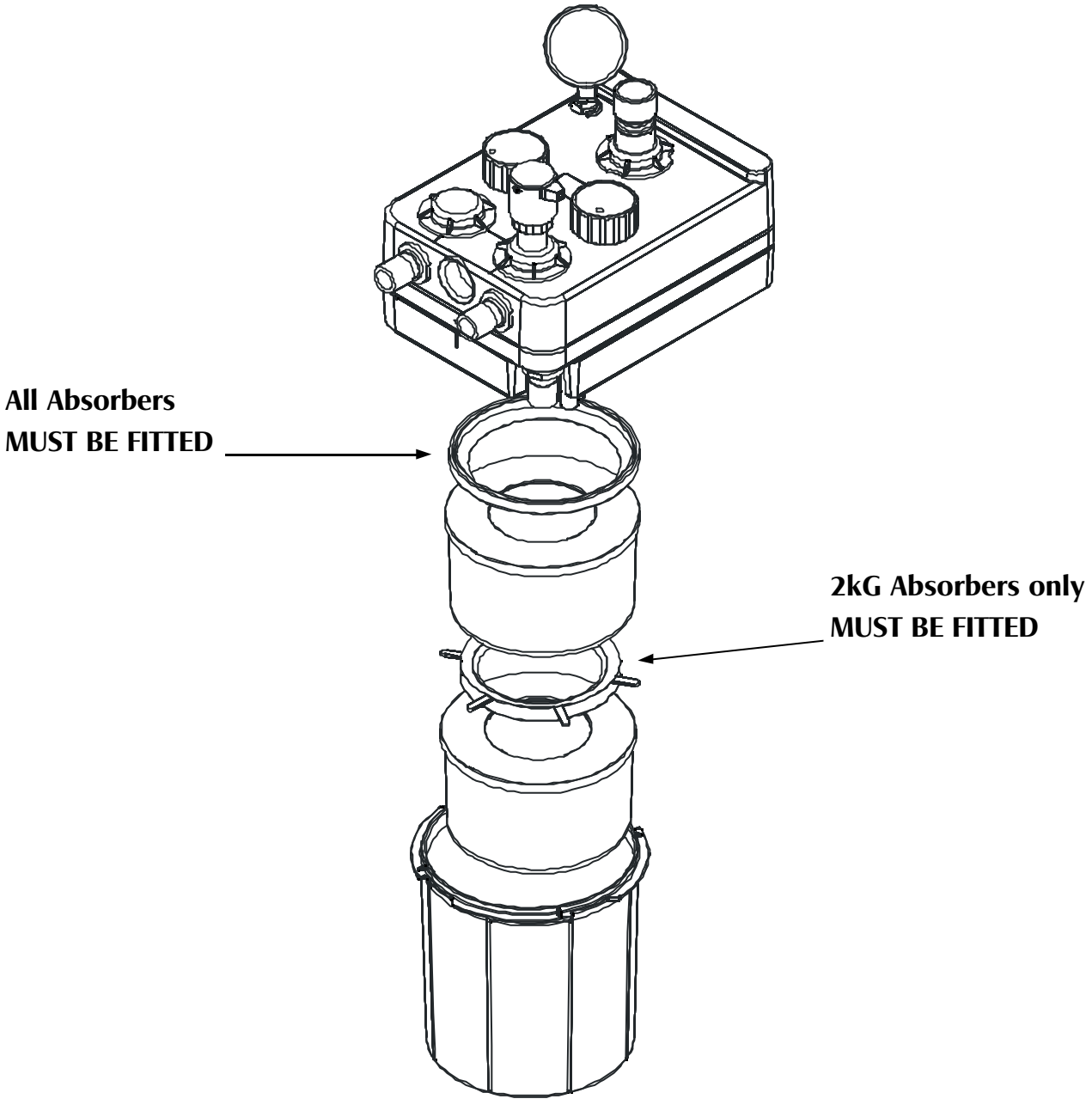


Figure 5 Exploded Diagram of Absorber



Notes

2.8 Checking Anaesthesia Equipment

INTRODUCTION

To check the correct functioning of anaesthetic equipment before use is a mandatory procedure. In 1997 the Association of Anaesthetists of Great Britain and Ireland published the second document of its 'Checklist for Anaesthetic Machines' which gained widespread acceptance in the profession. This section recognised that changes in anaesthetic equipment and the introduction of microprocessor -controlled technology would necessitate continued revision of the document in the future. This new edition further updates the procedures recommended in 1997.

The principles set out in previous booklets have governed amendments to this new edition. It must be emphasised that a major contributory cause of anaesthetic misadventures, resulting at worst in hypoxic brain damage or death, has been the use of anaesthetic machines and/or breathing systems which had not been adequately checked beforehand by an anaesthetist. It is the responsibility of all Trusts and other Hospitals to ensure that all personnel are trained in the use and

checking of relevant equipment. This is usually devolved to the Department of Anaesthesia, but where such a department does not exist, other arrangements must be made. The use of checklists and associated procedures is an integral part of training in Anaesthesia, and as such is part of the Royal College of Anaesthetists' Competency Based Training.

This checking procedure, applicable to all anaesthetic machines, should take only a few minutes to perform, and represents an important aspect of patient safety. It is not intended to replace any pre-anaesthetic checking procedures issued by manufacturers, and should be used in conjunction with them. For example, some modern anaesthetic "workstations" will enter an integral self-testing cycle when

the machine is switched on, in which case those functions tested by the machine need not be re-tested by the user. The intention is to strike the right level of checking so that it is not so superficial that its value is doubtful, nor so detailed that the procedure is impracticable.

The checking procedure covers all aspects of the anaesthetic delivery system from the gas supply pipelines, the machine and breathing systems, including filters, connectors and airway devices. It includes an outline check for ventilators, suction, monitoring and ancillary equipment.

There must be a system of implementing the routine checking of anaesthetic machines by trained staff according to the checklist, together with the manufacturer's instructions in every environment where an anaesthetic is given. A record should be kept, with the anaesthetic machine, that this has been done.

In addition, Trusts, Independent Hospitals, Service Hospitals and other organisations must ensure that all machines are fully serviced at the regular intervals designated by the manufacturer and that a service record is maintained. Since it is possible for errors to occur in the reassembly of machines, it is essential to confirm that it is correctly configured for use after servicing. The 'first user' check after servicing is therefore especially important and must be recorded.

Faults may develop during anaesthesia which were either not present or not apparent on the preoperative equipment check. This may include pipeline failure, electrical failure, circuit disconnections etc. In the event of any mishap it should not be presumed that the equipment is in the same state as when checked before the start of the case.

The checking procedure described in this publication is reproduced in an abbreviated form as a laminated sheet entitled "Checklist for Anaesthetic Equipment 2003". This laminated sheet should be attached to each anaesthetic machine and used to assist in the routine checking of anaesthetic equipment.

2.8.1 PROCEDURES

The following checks should be carried out at the beginning of each operating theatre session. In addition, specific checks should be carried out for each new patient during a session on any alteration or addition to the breathing system, monitoring or ancillary equipment. Implementation of these checks is the responsibility of the anaesthetist, who must be satisfied that they have been carried out correctly. In the event of a change of anaesthetist during an operating session the checked status of the anaesthetic equipment must be agreed.

Before using any anaesthetic equipment, ventilator, breathing system or monitor, it is essential to be fully familiar with it. Many of the new anaesthetic 'workstations' are complex pieces of machinery. It is essential that anaesthetists have a full and formal induction on any machines they may use. A short 'run-through' prior to an operating session is not appropriate.

The anaesthetic machine should be connected directly to the mains electrical supply (where appropriate), and only correctly rated equipment connected to it's electrical outlets. Multi-socket extension leads must not be plugged into the anaesthetic machine outlets or used to connect the anaesthetic machine to the mains supply.

To check the correct function of the oxygen failure alarm involves disconnecting the oxygen pipeline on some machines, whilst on machines with a gas supply master switch. The alarm may be operated by turning the master switch off. Because repeated disconnection of gas hoses may lead to premature failure of the Schrader socket and probe, the following guidelines recommend that the regular pre-session
check of equipment includes a "tug" test to confirm correct insertion of each pipeline into the appropriate socket.

It is therefore recommended that, in addition to these checks, the oxygen failure alarm must be checked on a weekly basis and a written record kept, by disconnecting the oxygen hose whilst the oxygen flowmeter is turned on. In addition to sounding an alarm which must sound for at least 7 seconds, oxygen failure warning devices are also linked to a gas shut off device. Anaesthetists must be aware both of the tone of the alarm and also what gases will continue to flow with the
make of anaesthetic machine in use.

A. ANAESTHETIC MACHINE

Check that the anaesthetic machine and relevant ancillary equipment are connected to the mains electrical supply (where appropriate) and switched on. Switch on the gas supply master switch (if one is fitted). Check that the system clock (if fitted) is set correctly. Careful note should be taken of any information or labelling on the anaesthetic machine which might refer to its current status.

B. MONITORING EQUIPMENT

Check that all monitoring devices, especially those referred to in the AAGBI Monitoring Standards document, are functioning and that appropriate parameters have been set before using the anaesthetic machine. This includes the cycling times, or frequency of recordings, of automatic non-invasive blood pressure monitors. Check that gas sampling lines are properly attached and free from obstruction or
kinks. In particular check that the oxygen analyzer, pulse oximeter and capnograph are functioning correctly and that appropriate alarm limits for all monitors are set.

C. MEDICAL GAS SUPPLIES

1. Identify and take note of the gases which are being supplied by pipeline, confirming with a 'tug test' that each pipeline is correctly inserted into the appropriate gas supply terminal.

2. Check that the anaesthetic apparatus is connected to a supply of oxygen and that an adequate reserve supply of oxygen is available from a spare cylinder.

3. Check that adequate supplies of any other gases intended for use are available and connected as appropriate. All cylinders should be securely seated and turned off after checking their contents.

4. Carbon dioxide cylinders should not normally be present on the anaesthetic machine. A blanking plug should be fitted to any empty cylinder yoke.

5. Check that all pressure gauges for pipelines connected to the anaesthetic machine indicate 400 - 500kPa.

6. Check the operation of flowmeters, where these are present, ensuring that each control valve operates smoothly and that the bobbin moves freely throughout its range without sticking. If nitrous oxide is to be used the anti-hypoxia device should be tested by first turning on the nitrous oxide flow and ensuring that at least 25% oxygen also flows. Then turn the oxygen flow off and check that the nitrous oxide flow also stops. Turn on the oxygen flow and check that the oxygen analyser display approaches 100%. Turn off all flow control valves. (Machines fitted with a gas supply master switch will continue to deliver a basal flow of oxygen.)

7. Operate the emergency oxygen bypass control and ensure that flow occurs without significant decrease in the pipeline supply pressure. Ensure that the emergency oxygen bypass control ceases to operate when released.

D. VAPORIZERS

1. Check that the vaporizer(s) for the required volatile agent(s) are fitted correctly to the anaesthetic machine, that any back bar locking mechanism is fully engaged and that the control knobs rotate fully through the full range(s). Ensure that the vaporizer is not tilted. Turn off the vaporizers.

2. Check that the vaporizer(s) are adequately, but not over, filled and that the filling port is tightly closed.

3. (i) Set a flow of oxygen of 5 litres/min and, with the vaporizer turned off, temporarily occlude the common gas outlet. There should be no leak from any of the vaporizer fitments and the flowmeter bobbin (if present) should dip.

   (ii) Turn each vaporizer on in turn and repeat this test. There should be no leak of liquid from the filling port. After this test, ensure that the vaporizers and flowmeters are turned off.

   (iii) Should it be necessary to change a vaporizer at any stage, it is essential to repeat the leak test. Failure to do so is one of the commonest causes of critical incidents.

   (iv) Removal of a vaporizer from a machine in order to refill it is not considered necessary.

E. BREATHING SYSTEM

1. Check all breathing systems which are to be employed. They should be visually and manually inspected for correct configuration and assembly. Check that all connections within the system and to the anaesthetic machine are secured by 'push and twist'. Ensure that there are no leaks or obstructions in the reservoir bags or breathing system and that they are not obstructed by foreign material. Perform a pressure leak test on the breathing system by occluding the patient-end and compressing the reservoir bag. Breathing systems should be protected at the patient-end when not in use to prevent the intrusion of foreign bodies.

2. Bain-type and circle co-axial systems - Perform an occlusion test on the inner tube and check that the adjustable exhaust valve, where fitted, can be fully opened and closed.

3. Check the correct operation of the unidirectional valves in a circle system.

4. If it is intended to use very low fresh gas flows in a circle breathing system, there must be a means to analyse the oxygen and vapour concentration in the inspiratory limb. (Under other circumstances these may be monitored at the anaesthetic machine fresh gas outlet.)

5. A new, single-use bacterial/viral filter and angle piece/catheter mount must be used for each patient. It is important that these are checked for patency and flow, both visually and by ensuring gas flow through the whole assembly when connected to the breathing system.

F. VENTILATOR

1. Check that the ventilator is configured correctly for its intended use. Ensure that the ventilator tubing is securely attached. Set the controls for use and ensure that adequate pressure is generated during the inspiratory phase.

2. Check that disconnect alarms are present and function correctly.

3. Check that the pressure relief valve functions correctly at the set pressure.

G. SCAVENGING

Check that the anaesthetic gas scavenging system is switched on and functioning. Ensure that the tubing is attached to the appropriate exhaust port of the breathing system, ventilator or anaesthetic workstation.

H. ANCILLARY EQUIPMENT

1. Check that all ancillary equipment (such as laryngoscopes, intubation aids eg intubation forceps, bougies, etc.) which may be needed is present and in working order. Ensure that all appropriate sizes of face masks, laryngeal masks, airways, tracheal tubes and connectors are available, and checked for patency at the point of use.

2. Check that the appropriate laryngoscopes function reliably.

3. Check that the suction apparatus is functioning and all connections are secure; test for the rapid development of an adequate negative pressure.

4. Check that the patient trolley, bed or operating table can be rapidly tilted head-down.

I. SINGLE USE DEVICES

Any part of the breathing system, ancillary equipment or other apparatus that is designated "single-use" must be used for one patient only, and not re-used. Packaging should not be removed until the point of use for infection control, identification and safety. (For details of decontamination of re-usable equipment, see the AAGBI Infection Control document.)

J. MACHINE FAILURE

In the event of failure some modern anaesthetic workstations may default to little or no flow. It is essential that an alternative oxygen supply and means of ventilation (e.g. self-inflating bag, circuit and oxygen cylinder, which must be checked as functioning correctly with an adequate supply of oxygen) are always readily available. Consideration should be given to alternative methods of maintaining anaesthesia in this situation.

K. RECORDING AND AUDIT

A clear note must be made in the patient's anaesthetic record, that the anaesthetic machine check has been performed, that appropriate monitoring is in place and functional, and that the integrity, patency and safety of the whole breathing system has been assured. There must also be a logbook kept with each anaesthetic machine to record the daily pre-session check and weekly check of the oxygen failure alarm. Documentation of the routine checking and regular servicing of anaesthetic machines and patient breathing systems should be sufficient to permit audit on a regular basis.

The Association of Anaesthetists of Great Britain and Ireland cannot be held responsible for failure of any anaesthetic equipment as a result of a defect not revealed by these procedures.

2.9 CHECKLIST FOR ANAESTHETIC EQUIPMENT 2003

The following checks should be made prior to each operating session. In addition, checks 2, 6 and 9 (Monitoring, Breathing System and Ancillary Equipment) should be made prior to each new patient during a session.

1. Check that the anaesthetic machine is connected to the electricity supply (if appropriate) and switched on.

Note: Some anaesthetic workstations may enter an integral self-test programme when switched on; those functions tested by such a programme need not be retested.

Take note of any information or labelling on the anaesthetic machine referring to the current status of the machine. Particular attention should be paid to recent servicing. Servicing labels should be fixed in the service logbook.

2. Check that all monitoring devices, in particular analyzer, pulse oximeter and capnograph, are functioning and have appropriate alarm limits.

- Check that gas sampling lines are properly attached and free of obstructions.
- Check that an appropriate frequency of recording non-invasive blood pressure is selected.

  (Some monitors need to be in stand-by mode to avoid unnecessary alarms before being connected to the patient).

Oxygen Monitor Test

The Oxygen Calibration menu allows adjustment of the displayed oxygen concentration to match the gas that the probe is exposed to; this is normally 100% pure oxygen.

NOTE: Calibration is only possible if the ventilator is in Standby and a probe is connected.

- Press the Main menu key, select Oxygen Calibration.
- Expose the probe to 100% pure oxygen flow or 21% room air.
- Adjust the displayed value to 100% or 21% as applicable by turning and pressing the Trak wheel.
- Press the Trak wheel again to start the calibration process. This takes approximately one minute and a countdown is displayed whilst it is in progress.

- Once the calibration process is complete return to the main screen, stop the flow of pure oxygen and expose the probe to room air for a few minutes.
- The oxygen concentration should nominally read 20.9+/-0.5%.

3. Check with a "tug test" that each pipeline is correctly inserted into the appropriate gas supply terminal.

Note: Carbon dioxide cylinders should not be present on the anaesthetic machine unless requested by the anaesthetist. A blanking plug should be fitted to any empty cylinder yoke.

- Check that the anaesthetic machine is connected to a supply of oxygen and that an adequate supply of oxygen is available from a reserve oxygen cylinder.
- Check that adequate supplies of other gases (nitrous oxide, air) are available and connected as appropriate.
- Check that all pipeline pressure gauges in use on the anaesthetic machine indicate 400–500kPa.

4. Check the operation of flowmeters (where fitted).

- Check that each flow valve operates smoothly and that the bobbin moves freely throughout its range.
- Check the anti-hypoxic device is working correctly.
- Check the operation of the emergency oxygen bypass control.

5. Check the vaporizer(s):

- Check that each vaporizer is adequately, but not over, filled.
- Check that each vaporizer is correctly seated on the back bar and not tilted.
- Check the vaporizer for leaks (with vaporizer on and off) by temporarily occluding the common gas outlet.
- Turn the vaporizer(s) off when checks are completed.

  Repeat the leak test immediately after changing any vaporizer.

6. Check the breathing system to be employed.

Note: A new single use bacterial/viral filter and angle-piece/catheter mount must be used for each patient. Packaging should not be removed until point of use.

- Inspect the system for correct configuration. All connections should be secured by "push and twist".
- Perform a pressure leak test on the breathing system by occluding the patient-end and compressing the reservoir bag. Bain-type co-axial systems should have the inner tube compressed for the leak test.
- Check the correct operation of all valves, including unidirectional valves within a circle, and all exhaust valves.

Circle Test–Valves

- Place 2 litre bag on flow sensor.
- Turn BAG/VENT switch to VENT.
- Vent will run, check that COMPLIANCE changes to ON after 2 or 3 cycles.
- Visually inspect the 2 valve discs for movement and sticking.
- Disconnect the expiratory limb from the absorber block and occlude the limb coming from the patient. No gas should flow out of the exposed port on the absorber block.
- Switch off vent and reconnect all vent parts , ensuring O_2 probe is connected.

- Check for patency and flow of gas through the whole breathing system including the filter and angle-piece/catheter mount.

7. Check that the ventilator is configured appropriately for its intended use.

- Check that the ventilator tubing is correctly configured and securely attached.
- Set the controls for use and ensure that an adequate pressure is generated during the inspiratory phase.
- Check the pressure relief valve functions.
- Check that the disconnect alarms function correctly.

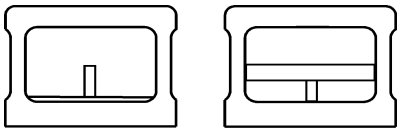
Ensure that an alternative means to ventilate the patient's lungs is available.

8. Check that the anaesthetic gas scavenging system is switched on and is functioning correctly.

- Check that the tubing is attached to the appropriate exhaust port of the breathing system, ventilator or workstation.

Scavenging Test

Connect the free end of the disposal hose to the hospital gas scavenging disposal system and check that the float is visible in the float window, as illustrated.



9. Check that all ancillary equipment which may be needed is present and working.

- This includes laryngoscopes, intubation aids, intubation forceps, bougies etc. and appropriately sized facemasks, airways, tracheal tubes and connectors, which must be checked for patency.

- Check that the suction apparatus is functioning and that all connectors are secure.

Suction Test

After assembling the suction system, a simple adjustment and test is required as follows:

Continuous Mode:

- Turn the mode switch to REG.
- Occlude the hose connected to the patient connection of the collection bottle.
- Wait for the vacuum reading on the gauge to rise and stabilise, then adjust the large knob to the maximum desired level
- Remove the occlusion.

Full Mode:

- Turn the mode switch to FULL.
- Occlude the hose connected to the output port of the regulator and verify that the gauge reads full available vacuum.
- Remove the occlusion. Verify that the high flow suction exists.
- Check that the patient trolley, bed or operating table can be rapidly tilted head down.

10. Check that an alternative means to ventilate the patient is immediately available. (e.g. self-inflating bag and oxygen cylinder).

- Check that the self-inflating bag and cylinder of oxygen are functioning correctly and the cylinder contains an adequate supply of oxygen.

11. Recording

- Sign and date the logbook kept with the anaesthetic machine to conform the machine has been checked.

  Record on each patient's anaesthetic chart that the anaesthetic machine breathing system and monitoring has been checked.

3.0 Full System Test

3.1 Full System Test

3.1.1 Leak Test

1. Ensure that:

- only one cylinder of each gas is fitted securely and correctly to the machine;
- no pipelines are connected to the machine;
- the cylinder is closed (turned off);
- all the flowblock assembly controls are turned fully clockwise;
- no equipment is plugged into the pneumatic power outlets;
- the machine is switched off;
- the low oxygen alarm level is set to 18% and the high oxygen alarm level to 99%;
- the oxygen transducer is connected and in room air.

2. Open the cylinder and check that its gauge indicates the cylinder pressure. Note the correspondence between the cylinders and their gauges.
3. Close the cylinder and check that the pressure indication on its gauge does not decrease.

   If any cylinder gauge indication decreases by more than half a division in three minutes an unacceptable leak exists. If the leak persists after ensuring that the cylinder is correctly installed, the machine should be referred to the Service Department.
4. Remove the cylinder and repeat the above procedure for each cylinder yoke in turn.
5. Remove the cylinder from the machine.
6. Attach each pipeline in turn and check that each pipeline supply pressure gauge is indicating the correct pressure.
7. Open all flow valves by turning all the control knobs fully counter-clockwise. With the oxygen connected at all times turn on the machine and check that each cylinder and pipeline in turn (including oxygen) registers a flow on the appropriate flowblock assembly and discharges through the fresh gas outlet. Turn the machine off when complete.

3.1.2 On/Off Switch and Warning System Checks

1. Switch on the machine.
2. If the oxygen supply failure alarm operates for more than a few seconds, check that oxygen supply cylinders or pipeline are correctly installed and at the correct pressure.
3. The machine is fitted with a mechanical hypoxic guard, check that there is a standing flow of 130 to 170 ml/m through the oxygen flowblock assembly with the oxygen flow control turned fully clockwise.
4. Increase the oxygen flow to approximately 4 l/m.
5. Turn all the flow control valves counter-clockwise so that the flow indicated by each flow tube assembly is 1 l/m.
6. Simulate an oxygen supply failure by shutting off or disconnecting the oxygen supply cylinder(s) or pipeline(s).
7. Check that the oxygen failure warning device is activated after the pressure of the oxygen remaining in the machine has fallen, ensuring that:

- Its whistle sounds for at least 8 seconds;
- All the other gases on the machine are cut off with the exception of Air if fitted (I.e. the readings on their flowblock assemblies indicate zero).

8. Reconnect the oxygen supply and check that:

- The oxygen failures alarm is cancelled;
- The gas flows through the flowblock assemblies are restored.

9. Disconnect or shut off the nitrous oxide supply (cylinder and/or pipeline) and check that:

- The flow indicated in the nitrous oxide flowblock assembly reduces to zero;
- The flows indicated on the other flowblock assemblies remain unaltered.

10. Reconnect or turn on the nitrous oxide supply.
11. Repeat 9 and 10 for all the other gas supplies on the machine.

3.1.3 Mechanical Hypoxic Guard Test

The machine has a mechanical hypoxic guard fitted its function should be tested as follows.

1. Turn the oxygen and nitrous oxide flow control valves fully clockwise.
2. Check that the oxygen flow indicated on the oxygen flowblock assembly is 130 to 170ml/m and that no flow is indicated on the nitrous oxide flowblock assembly.
3. Increase the nitrous oxide flow (turn the knob counter-clockwise) to 10 l/m and check that the oxygen flowblock assembly indicates an oxygen flow of 3.15 to 4.7 l/m.
4. Turn the oxygen flow control counter-clockwise until an oxygen flow of 6 l/m is indicated.
5. Check that the indicated nitrous oxide flow remains between 9.5 and 10 l/m.
6. Gradually reduce the oxygen flow and check that the nitrous oxide flow has begun to decrease when the oxygen flow decreases below 2.8 l/m.
7. Turn the oxygen flow control clockwise until a flow of 1.5 l/m is reached. Check that the nitrous oxide flowblock assembly is reading 3.5 to 6.6 l/m.
8. Turn the nitrous oxide control fully clockwise.
9. Ensure all the flow control valves are turned fully clockwise and then switch the machine off.

3.1.4 Oxygen Flush Tap Test

With only oxygen connected to the machine, verify that the oxygen flush discharges gas through the common gas outlet.

3.1.5 Auxiliary Outlet Test

1. To test the oxygen, attach oxygen only to the machine and verify that gas flows from the oxygen auxiliary outlet when connected.
2. To test the air, attach oxygen only to the machine and verify that no gas flows from the Air auxiliary outlet when connected. Attach air to the machine and verify that there is flow from the Air auxiliary outlet when connected.

3.1.6 Vaporizer Test

See 3.1.1 Leak Test.

3.1.7 Ventilator Test

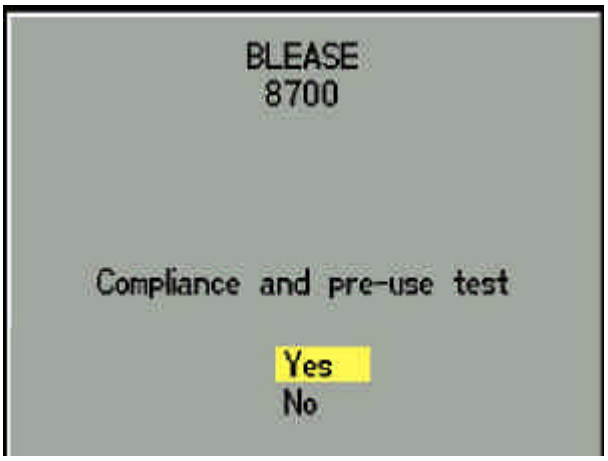
Is contained in the Pre-Use Testing that follows;

3.2 Pre-use Testing 8700 Ventilator

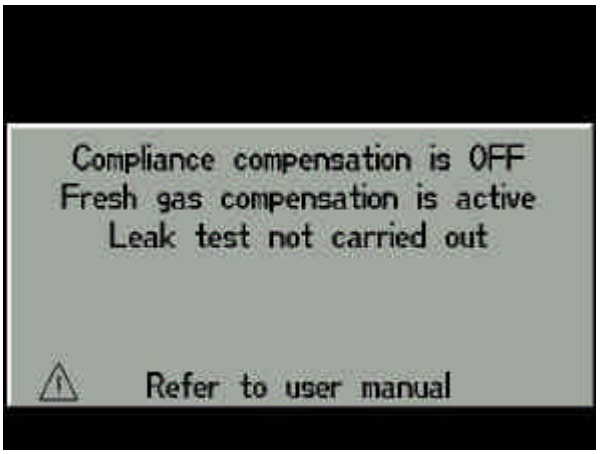
Please read the following instructions in conjunction with the information on Compliance compensation contained in the Installation section of this manual.

The patient airway flow sensor head must be in the patient circuit in order to carry out compliance compensation.

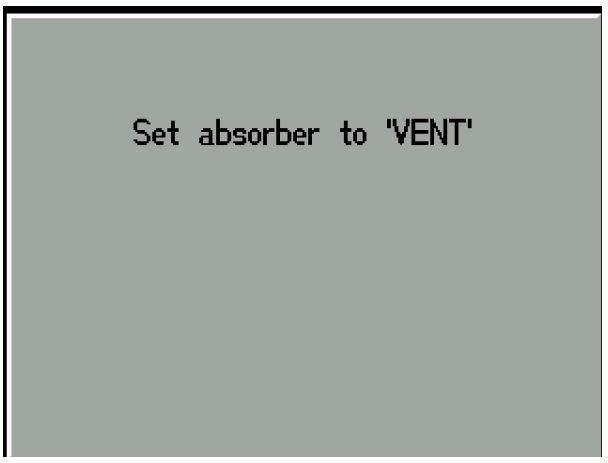
The option to run a Pre-Use Test for Compliance Compensation is built into the Startup menu.



The opening screen at switch on.

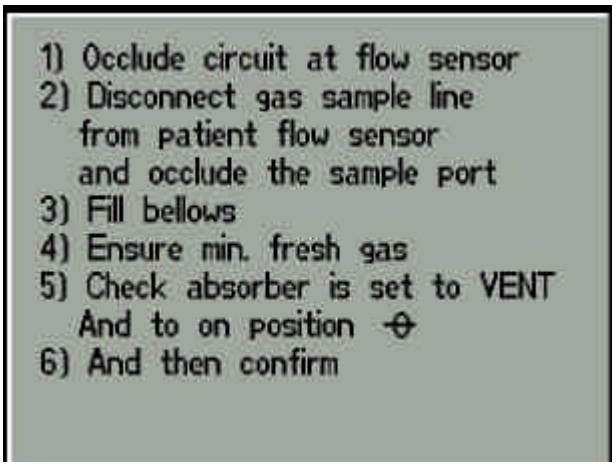


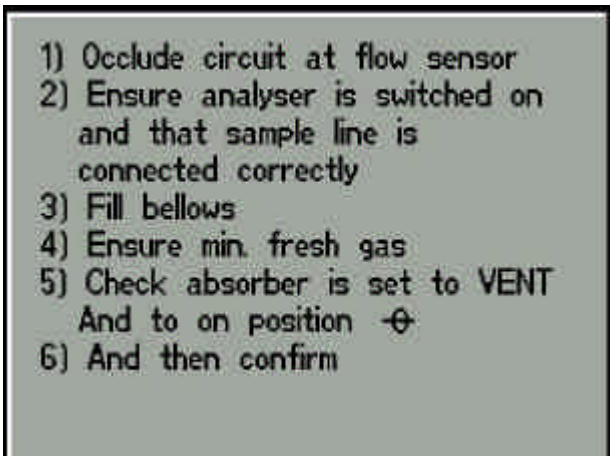
The warning screen if the pre-use is cancelled.



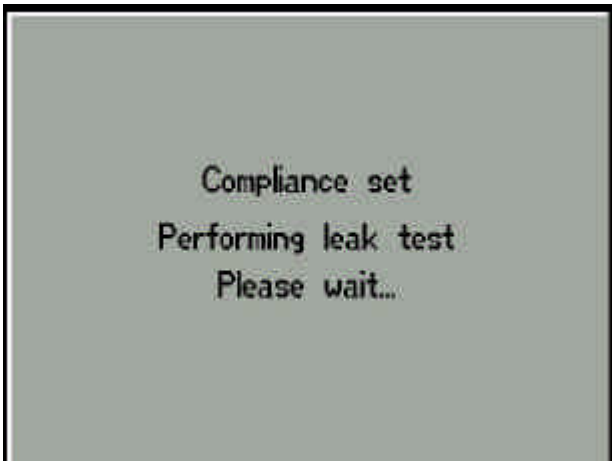
Following YES this is the start screen for the pre-use tests. Follow all on screen instructions.

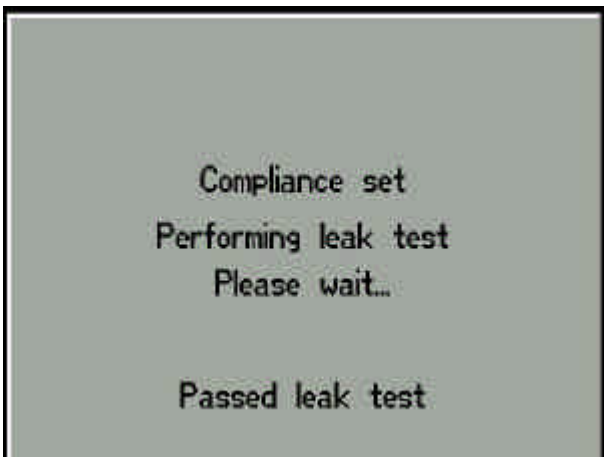
At this stage 1 of 2 screens may appear depending on how the gas analyser is set-up. The left screen is if the analyser is scavenged or the right if the analyser exhaust is returned to the circle.



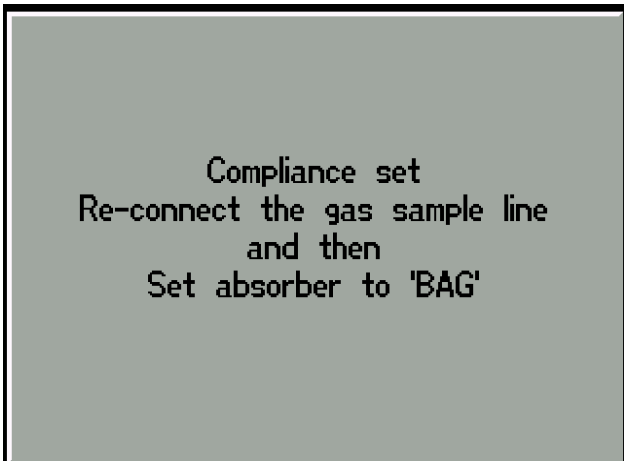


The instructions given are the preparation for performing 3 ventilator tests.
1. PEEP Valve calibration, 2. Calculation of system dead space (compliance), 3. Leak Test.



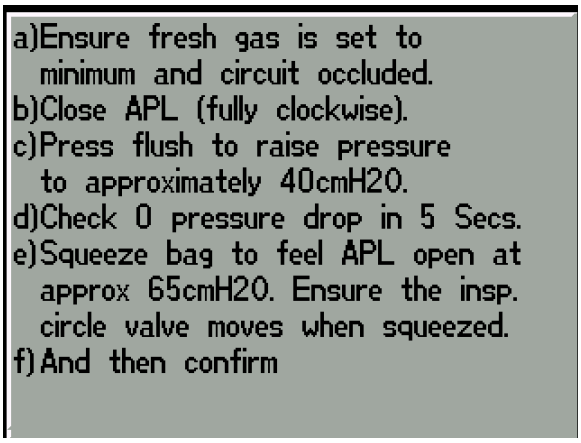


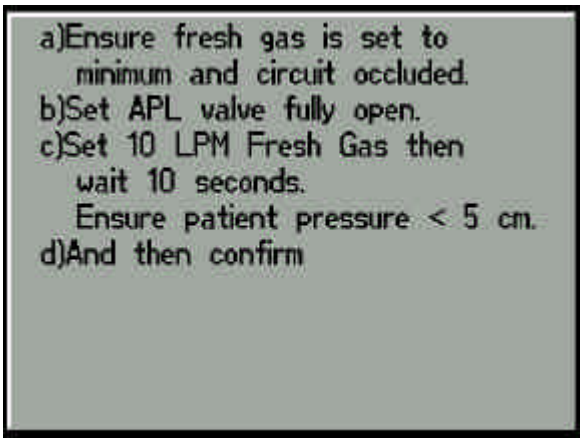
Having calibrated the PEEP valve and measured the dead space the leak test starts on the left and concludes with the right hand screen after 20 seconds.



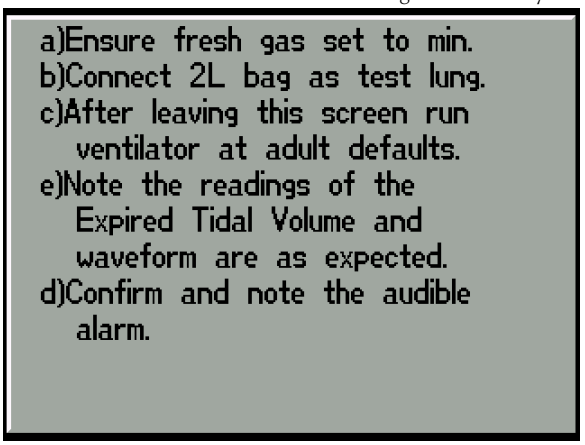
Having successfully passed the leak test the option is given to test the Manual or Bag system of ventilation. Making a no decision at this point will enter the normal run screen. Yes will follow on to the preparation for system test.

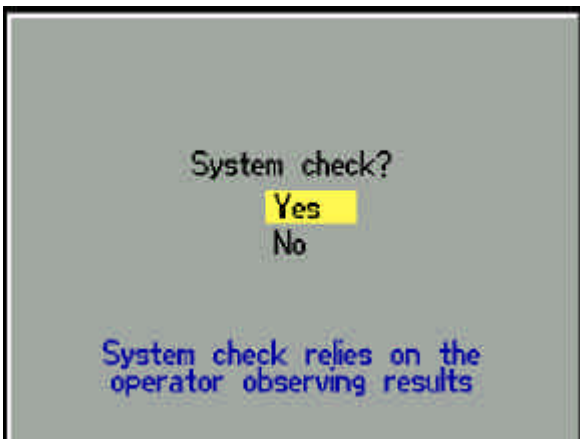
The following 3 screens are the Gas Machine Tests.





NB. This is just a set of instructions it is not an active test. Set the controls as instructed and carry out the manual test as instructed making the necessary observations that all is working as correctly.





Having proved that the manual system works the ventilator can be tested at nominal settings of TV 500 mL, 12 BPM, I:E 1:2.0 Set up the system as described Press the track wheel when ready and set the Bag/Vent switch to Vent. Ensure that the Bag and Bellows are full. Observe the displayed wave form and expired volume are consistent with the expected result. Other tests can be carried out at the users discretion.

When this test is completed satisfactorily the system is ready for use.

The PEEP valve is tested during the Pre-Use test. If the valve is replaced or fitted during use the Pre-Use test must be carried out to ensure continued accurate operation.

In later production systems an improved compliance compensation system has been implemented. This has been improved in two ways:-

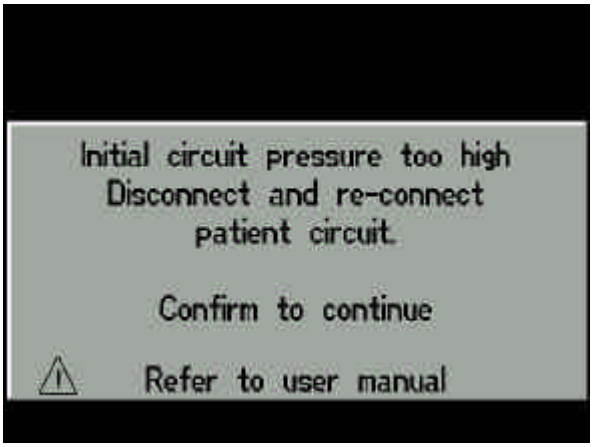
a. The pressure used in compensation is now averaged instead of using the last peak.

b. If a pressure limit is activated that peak is not fed into the average.

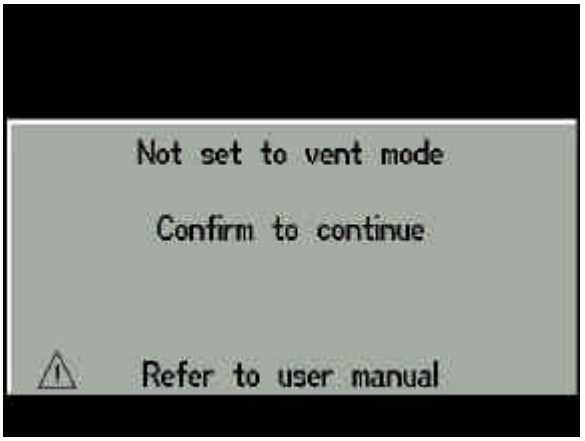
c. A rolling average of airway pressure is calculated that is used to monitor each delivered breath. If the pressure rise is more than 25% above this rolling average an automatic limit will be applied for that breath. This prevents abnormal high pressures being generated due to patient movement or other artefacts. If a limit is activated this pressure will not be included in the average.

3.2.a Pre-use Test Error Messages

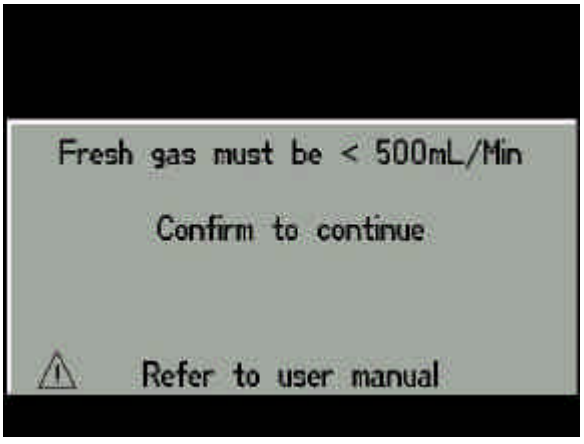
If errors are encountered during the pre-use test then one of the following screens will be displayed. The screens are designed to give an indication of what may have caused the error and possible solution.



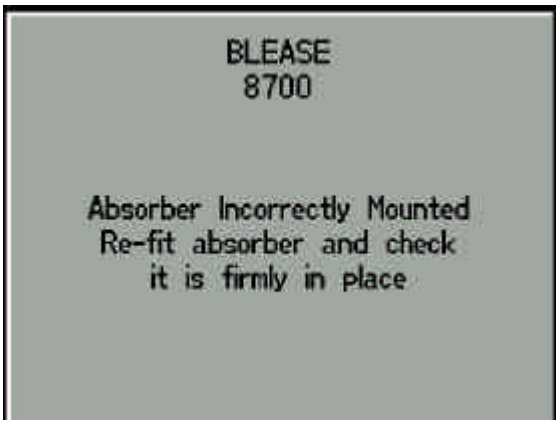
This screen suggests that the patient pressure is too high (>4cmH2O) to begin the test.



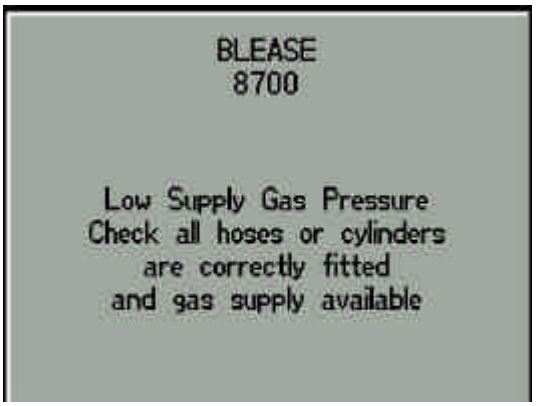
If the absorber is not set to Vent when starting the test the system will give a reminder.



Fresh Gas too High. Reduce and Re-Start.



Pull forwards a couple of cm, check no foreign objects are between the absorber and main frame, push

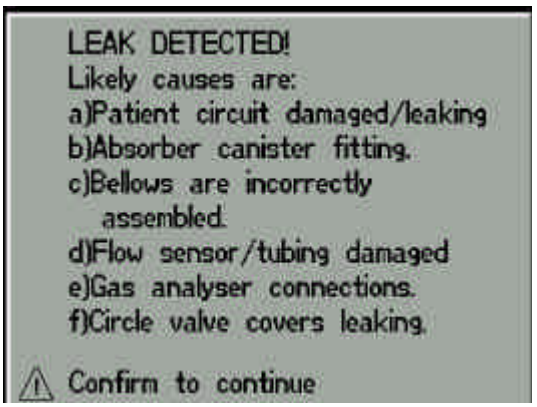


Check the gauges for correct gas supply.

Failure to fill the bellows at the start

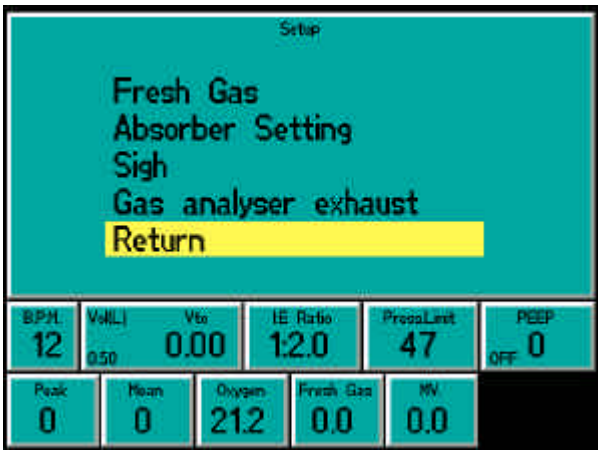
If the system has a leak that is too large or if the circuit is not occluded correctly the test will fail at this point.

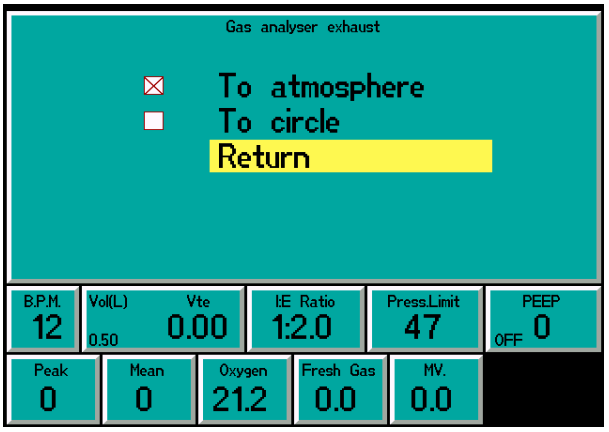
NB. It has been noted that this can be caused by fitting a Re-Breathing bag to the "Y" connector instead of occluding the circuit on the plug provided on the absorber.



If a leak is detected the above causes are the possible places to look. It should be noted that these are not the only leak possibilities, small holes in the sensor tubing, Cracks in Breathing circuits are sometimes possibilities too.

Below are the screens that set-up the conditions affecting the opening Pre-use screens regarding gas analyser exhaust positioning.





The gas analyser exhaust gas can be dealt with in two ways a) it can be simply exhausted to atmosphere (scavenged) or b) it may be returned to the circle. These choices need to made by the hospital and the selection made at the time of commissioning the system. The selection can have marked effects on he leak tests carried out during the pre-use testing.

If the sample line is disconnected but the exhaust is returned to the circle then it may mask leaks by providing an additional gas input. If the reserve situation I.e. the sample line is connected but the exhaust is not then it would constitute a leak.

3.3 Pre-use Testing 6700 Ventilator

The patient airway flow sensor head must be in the patient circuit in order to carry out compliance compensation.

The PEEP valve is tested during the Pre-Use test. If the valve is replaced or fitted during use the Pre-Use test must be carried out to ensure continued accurate operation.

The option to run a pre-use test is built into the start-up screen. It is initiated by pressing the '✍' key or skipped by pressing the 'alarm reset' key. If the compliance compensation test is skipped the message "compliance cancelled, no compensation" is displayed.

Follow the instructions given on screen and the ventilator will perform a Pre-use test and a leak test.

On satisfactory completion of the compliance compensation test "compliance set ok" is displayed.

If any part of either the leak or compliance test is failed, the user will be alerted by an on screen message as to which test has been failed and instructed to press '✍' to retry. At this point the user can elect to skip the test or to retry.

During Pre-use Test if fresh gas is set to greater then basal flow then compliance will fail and the 'fresh gas too high' message will be displayed

In later production systems an improved compliance compensation system has been implemented. This has been improved in two ways:-

a. The pressure used in compensation is now averaged instead of using the last peak.

b. If a pressure limit is activated that peak is not fed into the average.

c. A rolling average of airway pressure is calculated that is used to monitor each delivered breath. If the pressure rise is more than 25% above this rolling average an automatic limit will be applied for that breath. This prevents abnormal high pressures being generated due to patient movement or other artefacts. If a limit is activated this pressure will not be included in the average.

Notes

4.0 Maintenance

4.1 Cleaning and Sterilisation

4.1.1 Main Unit

Stainless Steel, Painted and Anodised Aluminium components and surfaces should be cleaned with a damp cloth and mild soap. Abrasive cleaners should NOT be used.

Clear plastic areas (flowblock assembly and gauge faces) should be cleaned with a damp, soft clean cloth and dried immediately with a dry cloth to prevent spotting.

4.1.2 Absorber

The absorber should be cleaned as and when required.

Do not use caustic substances such as trichlorethylene for cleaning the absorber as it may damage the surfaces.

Do not autoclave the manometer.

WARNING: The condensate in the bottom of the outer canister is caustic.

1. Remove the outer canister.
2. Remove the inner canisters and dispose of the contents (refillable only) or the canisters themselves. Pour out any condensate from the bottom of the outer canister.
3. Remove the manometer, if fitted.
4. Remove the non-return valves by turning counter-clockwise to disengage the bayonet fitting and then lifting out. Remove the valve discs.
5. Remove the APL valve by lifting the spring-loaded APL cover stop then turning the cover counter-clockwise to disengage the bayonet fitting, and lifting out. Remove the valve disc.
6. Set the Bypass valve to Absorber On.
7. Wash all components in hot water and dry using a lint-free cloth. Check for and remove any small particles of soda lime, which can destroy the integrity of valves and seals.
8. Pack all components separately in the autoclave for sterilisation at 2 Bar for the duration of one standard cycle.

Autoclave the canisters and separate plastic parts in an upright position and away from other components.

1. After sterilisation, re-assemble the components. Ensure the large seal around the black interface moulding, on the underside of the absorber, is free from soda lime dust and lubricate with a Fomblin PTFE-based grease. After cleaning and lubricating, check that the seal is firmly in place, as the absorber cannot function correctly without it.
2. Carry out the pre-use checks.

4.1.3 Peep Valve

1. Disconnect the control cable from its socket.
2. Remove the actuator unit from its mounting by holding the main body and turning the grooved lock ring clockwise until the unit separates.

The actuator section must not be immersed or sterilized. Use only a mild detergent / anti-bacterial cleaner to wipe the surfaces and cable.

3. Remove the valve cover by turning anticlockwise to disengage the bayonet fitting and lifting out remove the valve disc.
4. These parts should be packed and autoclaved for sterilisation at 2 bar for the duration of one standard cycle
5. Reassembly is the reverse of this procedure.

Warning: Some anaesthetic agents may adversely affect the paintwork. Any spillage should be removed immediately.

4.1.4 Ventilator Surface

Warning: Do not clean the LCD screen with liquid. Use only a dry, soft, lint free cloth.

4.1.5 Pop-Off Valve Seat

1. Remove the bellows housing and bellows.
2. Loosen the black thumbscrews and remove the pop-off valve.
3. Clean the valve seat carefully using a soft, lint free cloth.
4. There is an O-ring located in the bellows base, (see opposite) which provides a seal with the pop-off valve,. After cleaning, check that the O-ring is in place, as the ventilator cannot function correctly without it.

If the valve seat is damaged, the pop-off valve will leak and may cause serious malfunction. Take care not to damage the precision-moulded surface of valve seat while cleaning. Never use a hard object or abrasive detergent. Use only a soft, lint-free cloth.

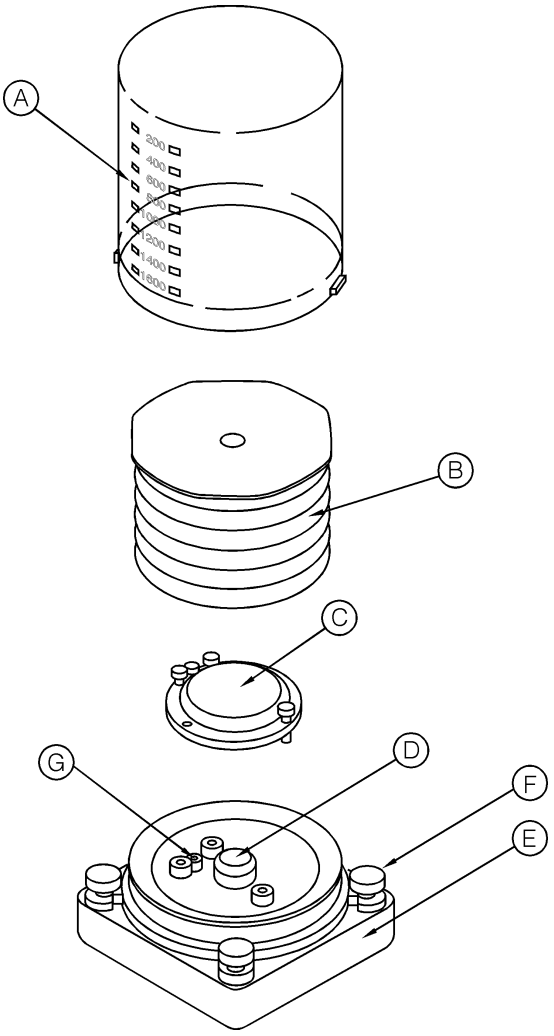


Figure 6 Removing the Pop-off Valve

A	Cover	**E**	Bellows Base
B	Bellows	**F**	Fixing Screws
C	Pop-off valve	**G**	O-ring
D	Valve seat		

4.1.6 Patient Airway Flow Sensor

The flow sensor can be hand or machine washed and disinfected with a suitable disinfectant. Steam autoclaving *must not exceed* 134°C. The sensor can be sterilised with ethylene oxide.

To clean the flow sensor, pour distilled water slowly and gently into the outlet port. Water must not be directed into this port under pressure.

Chemical decontaminants or liquid sterilisation agents will damage the sensor and must NOT be used for cleaning or sterilising. If autoclaving the sensor, the autoclave must only be used with distilled water.

4.1.7 Blanking cap on patient flow sensor is NOT autoclavable.

Bellows

Only the bellows base and the parts inside the bellows require sterilisation.

To avoid damage to the equipment:
Peak sterilisation temperature must not exceed 134°C.
Do not sterilise the control unit.
Gas sterilisation should be followed by quarantine in a well-ventilated area to allow dissipation of residual absorbed gas.
Follow the sterilisation agent manufacturer's instructions.
The expiratory valve must be disassembled prior to autoclaving to prevent the occurrence of clamping stresses.

The paediatric adapter, can be sterilised but must not be autoclaved.

1. Pull absorber forward to disconnect the bellows base.
2. Loosen the two thumb screws retaining the bellows base and remove the bellows base and housing from the control unit.
3. Remove the pop-off valve and paediatric bellows adapter (if fitted) and clean and sterilise them separately.
4. Perform sterilisation as specified in the table opposite.

4.1.8 Methods of Sterilisation

ITEM	METHOD
Bellows*	Gas[1], liquid[2], autoclave[3]
O-ring	Gas[1], liquid[2], autoclave[3]
Bellows housing*	Gas[1], liquid[2], autoclave[3]
Bellows base*	Gas[1], liquid[2], autoclave[3]
Paediatric adapter	Gas[1], liquid[2]
Pop-off valve	Gas[1], liquid[2] autoclave[3]
Pop-off diaphragm	Gas[1], liquid[2] autoclave[3]
Control unit	Do not sterilise
Patient Airway Flow sensor	Gas[1], liquid[2], autoclave 132° C max N.B. The white plastic blank is not Autoclavable.

Notes:

1. Ethylene oxide, 54°C max.
2. Eg. Cidex, Sporicidin, Sonacide.
3. Steam autoclave, 134°C max.

The autoclavable bellows base has a 30 mm diameter exhaust port, the canister is smokey grey with ribs around it and there are four large lugs. The rubber bellows has a plastic coated metal top plate. Older type canisters are clear with only two lugs. Old style bellows have a solid plastic top plate.

The Paediatric canister cannot be autoclaved.

5.0 Routine Maintenance

5.1 Routine Maintenance

5.1.1 Weekly Checks

5.1.1.1 Control Unit

1. Connect the main electrical power and turn the Patient Selection Switch to Adult or Paediaitric.
2. Disconnect the mains supply and check that the MAINS FAIL alarm activates.
3. Reconnect the mains electrical power and check that the alarm resets.
4. Turn the ventilator on.
5. Disconnect the O2 and Air hose and turn off the O2 cylinder. The SUPP GAS LOW alarm should activate.

5.1.2 Six-Monthly Checks

5.1.2.1 Bellows

Each time the bellows assemblies are opened for cleaning, all visible parts should be inspected carefully and damaged components replaced. The bellows material deteriorates with age and use, and should be examined and replaced, if necessary every six months.

5.1.2.2 Other Maintenance

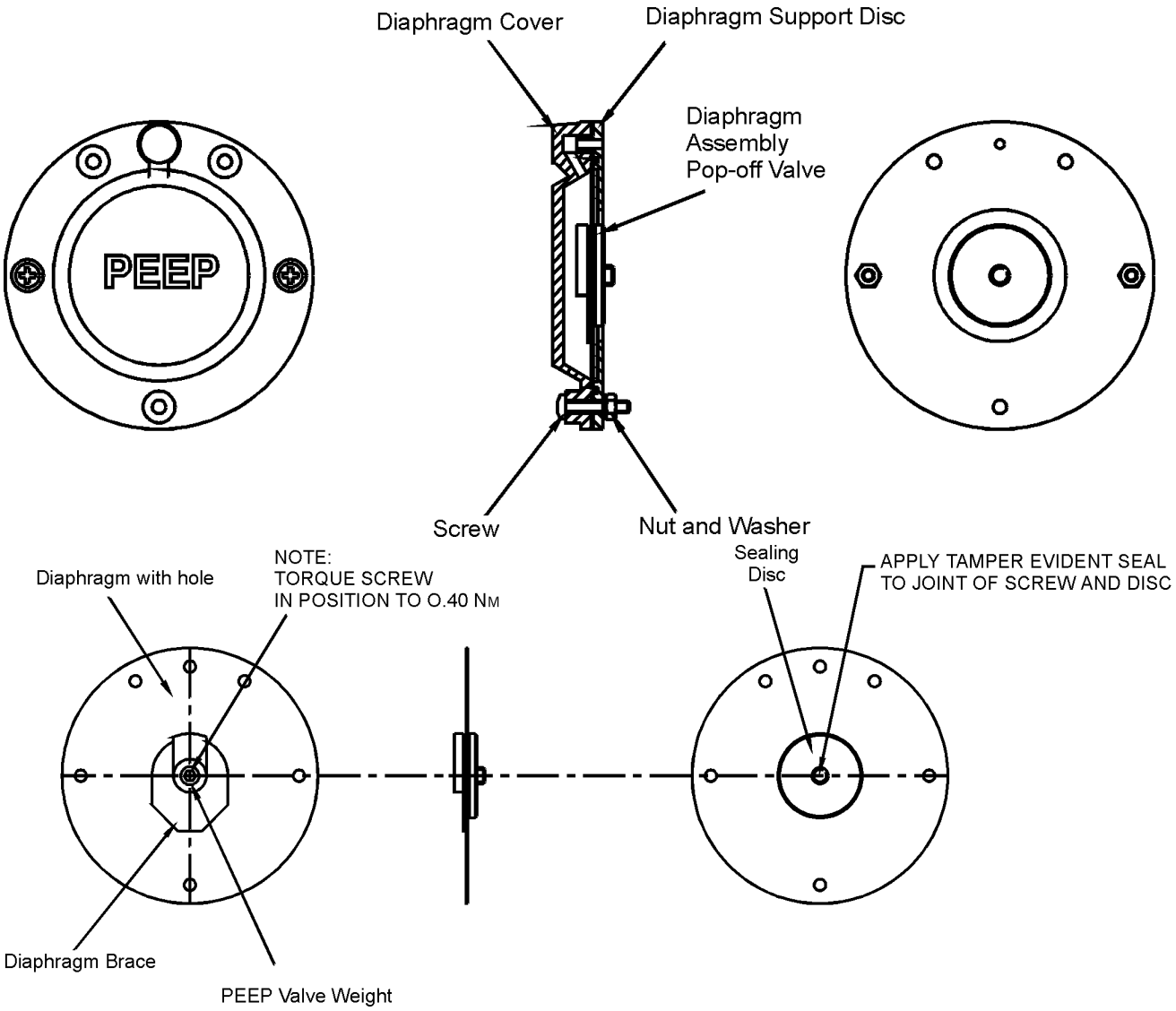
Occasionally, maintenance may be required on terms that are not covered by periodic routine maintenance tasks.

5.1.2.3 Exchanging Fuses

WARNING: The use of incorrectly rated fuses constitutes a fire hazard. Replace the two fuses only with the correct type and rating of fuse.

1. At the rear of the machine behind the cylinder positions is a small hatch.
2. Unscrew the three screws and lift off the hatch to reveal the fuses in the holder.
3. Exchange the fuses and then replace the hatch.
4. Tighten the screws.
5. If the fuse fails a second time contact a Service Engineer.

Figure 7 PEEP Pop-Off Valve Assembly



Notes

6.0 Planned Maintenance

6.1 Routine Maintenance

6.1.1 Planned Preventative Maintenance

6.1.1.1 Service Schedule

The recommended planned preventative maintenance should be completed in the following sequence.

6.1.1.2 Every 6 months

- Maintenance Checks
- Overall Visual Inspections
- Oxygen Monitor Calibration
- Cylinder Pressure/Leaks
- Pipeline Pressure/leaks
- Full System Test

6.1.1.3 Every 12 Months

- Fit Service Kit Part No. 13600530
- Maintenance Check as 6 months
- Full System Test

6.1.1.4 Every 48 Months

- Fit Service Kit Part No. 13600531
- Maintenance Check as 6 months
- Full System Test

Test Equipment Required:

- Pressure Gauge 0-100cmH2O (manometer)
- Volume Measuring Device (wights respirometer)
- Test Lung

6.1.2 Detailed Maintenance Checks

See section 7. for ordering information on service items.

6.1.3 Overall Visual Inspection

Should any of the checks indicate a mechanical fault, damage or deterioration, the item should be adjusted or replaced.

6.1.4 Visual Inspection

Check that the following are free from damage and are securely mounted to the machine and/ or their fittings:

- Yoke Blocks, their index pins and bridges;
- Pipeline inlets;
- Pipeline hoses for deterioration or damage;
- Pipeline ferrules and colour coding; tug test to ensure they remain intact;
- Absorber Brackets;
- Pneumatic power outlets;
- Backbar;
- Oxygen Flush Assembly;
- Common Gas Outlet;
- Flowmeter assembly and control knobs;
- Drawer/s;
- Castor, buffers and fixings;
- Pneumatic components including the regulators, reservoir, etc and the associated nuts, screws, couplings and pipework.

6.1.5 Structural

Check the general condition of the structure, and that welded joints are free from cracks. Check that all screws are tightened and in good condition.

6.1.6 Castors

1. Ensure the castors are located securely within the frame uprights.
2. With the brakes released, ensure that the trolley can be pushed or pulled in any direction without the castors feeling 'lumpy' or stiff, producing squeaks or grinding noises or exhibiting excessive chatter or wobble.
3. Hold the sides of the work surface support/machine frame and keeping the castors pointing in the same direction rotate the trolley in a counter-clockwise and clockwise circle and ensure that each of the castors rotates without stiffness or jerks through 360^{O} in both directions.
4. Press the brake button on each of the front castors and check that as the trolley is pushed or pulled the front castors remain locked.
5. Release the brake button and check that the wheels rotate freely as the trolley is pushed or pulled.
6. Lubricate the castors if necessary.

6.1.7 Drawer Operation

1. Check that the drawer rotates smoothly and remains secure when it is closed.

6.1.8 Common Gas Outlet (fixed) and Oxygen Flush Operation

1. Check that the surface of the 22mm connector is free form damage.
2. Check that the oxygen flush button operates smoothly and returns fully when released.

6.1.9 Ancillary Equipment and Mountings

1. Check that the operation of the brackets, clamps and arms used to mount ancillary equipment is smooth and not over-tight or too loose.
2. Visually inspect circuits, ensuring both inner and outer tubes (if fitted) are properly located on the hose end fittings, and not twisted or kinked.
3. Visually inspect all external rubber tubing, reservoir bags and patient system connectors.

6.2 Pipeline Leak Test

Ensure that:

- No cylinders are attached to the machine.
- The machine is switched off.
- The pipeline supplies are connected to gas specific pipeline outlets.
- Turn on each of the supplies in turn, checking that the appropriate pipeline supply pressure gauge indicates the supply pressure.
- Shut off the supply and check that the gauge indication does not decrease by more than half a division in three minutes.
- Disconnect pipelines from the supplies.

6.3 Suction System Test

- Ensure the controller is in the OFF position.
- Connect to a vacuum.
- Ensure that the gauge registers about 0mmHg and that no suction is available.
- Switch the controller to the FULL position.
- Ensure that the gauge registers around –100 to –200mmHg and that when the inlet is occluded the gauge registers about –500mmHg.
- Switch the controller to the REG position.
- Ensure that the gauge registers a vacuum which can be varied between –200 and -500mmHg, when the inlet is occluded.

6.4 Scavenging Test

- Connect to vacuum.
- Ensure that the green float rises to the window.
- Occlude port on filter assembly ensure gauge reads >450mm Hg.

6.5 Cylinder Leak Tests

- Fit and open one cylinder of each type of gas and check that the cylinder gauges register the cylinder pressure.
- Close each cylinder and check that the reading on the contents gauges do not fall by more than half a division in three minutes.
- Repeat for additional cylinders.
- Turn machine to the N_2O position, turn oxygen cylinder on, and turn nitrous oxide cylinder on then off.
- Check that the reading on the nitrous oxide contents gauge does not fall by more than half a division in three minutes.
- Using the test points behind the small lower access panel each gas regulator output pressure can be measured.
- All regulators are set to 360kPa ± 20 (52psi, ± 2).

Note that the oxygen failure warning device may momentarily activate when the oxygen is first turned off. Allow 15 seconds for the reservoir to fill.

N2O cylinder gauges do not have division markings. Check that the gauge pointer does not fall the equivalent distance in three minutes.

6.6 Hypoxic Guard

- With oxygen and nitrous oxide connected to the machine switch to the N2O position.
- Turn the oxygen flow rate to 10lpm, return it to 4lpm to calibrate an oxygen analyser.
- Check that the basal flow is between 0.15 ± 0.02lpm and that the bobbins revolve.
- Attempt to create a hypoxic mix (oxygen concentration less than 21%).
- If hypoxic mixture can be produced then this constitutes a failure.

Flow Control Valve

- Turn each flow control valve fully counter clockwise in turn, checking that the torque required to turn remains constant without any sudden changes in its 'feel'.
- Check that the maximum flow reading on the flowmeter can be obtained.
- Turn the flow control valve fully clockwise, checking that the torque required to turn remains constant without any sudden changes in its 'feel'.
- Check that the flow is zero for standard flow control valves, or 150ml ± 30ml for oxygen.
- Set the flow to approximately 25% of the flowmeter's range.
- Check that an axial or lateral force does not change the flow by more than 10%.
- Release the knob and check that the flow returns to that set in 7.

Flowmeter Accuracy

- Turn all the flowmeter controls fully clockwise.
- Turn an oxygen cylinder or pipeline on.
- Connect a calibrated flowmeter to the common gas outlet of the machine.
- Turn the oxygen flow control counter clockwise to set the oxygen flow at the major calibration points on the flowmeter as detailed in the calibration record (Checklist and Calibration record).
- Using the calibrated flowmeter check that the gas flow from the common gas outlet is within 10% of the combined flow indicated on the machine flowmeters.
- Turn the oxygen flow control fully clockwise.
- Repeat for all flowmeters on the machine.

6.7 Switch / Anti-confusion / Oxygen Monitor / Oxygen Failure/ Oxygen Flush

- Connect one source of each gas.
- Switch the machine to the N2O position.
- Check that there is a basal flow of 0.15 ± 0.02lpm through the oxygen flow meter with the oxygen flow control turned fully clockwise.
- Increase the oxygen flow to 0.5lpm.
- Connect an oxygen analyser to the CGO - reading should be above 98%.

- Turn N_2O to 0.5lpm, check oxygen reading is 48-52%.
- Switch the machine to Air.
- Turn Air to 0.5lpm, check oxygen reading is 58-62%.
- Turn the switch OFF and check that all gases are switched OFF.
- Turn the switch to N_2O and then to Air and check that the appropriate gases are restored.
- Turn the switch to N_2O ad disconnect the oxygen supply.
- Check that the audible alarm sounds for at least 8 seconds, N_2O is switched OFF and Air is restored.
- Check that Air is available from the CGO, whatever the position of the switch.
- Check the ventilator does not suffer a supply gas failure.

Oxygen Flush Control Tests

- Ensure that the oxygen flow control is turned fully counter clockwise, that the only supply on the machine is a single oxygen source, and it is turned ON.
- Turn ON the machine and check that a gas flow of 150 ± 30ml/min is indicated on the oxygen flowmeter.
- Connect a flowmeter or peak flow gauge that will read 60 l/m of oxygen to an accuracy of ±5% to the common gas outlet.
- Operate the oxygen flush control by pushing it in, and check that the action of the control is smooth and free from stiffness or looseness, and that gas flows from the common gas outlet whilst the control is being passed.
- Check that the flow is within the range 45 to 50 l/m.
- If a flowmeter is not available, connect a 2-litre bag and ensure it fills within 3 seconds.
- Alternatively a respirometer and stop watch may be used to check the flow.
- Release the control and check that it returns to its original position without jerks and the gas flow ceases at the common gas outlet.
- Remove the flowmeter or bag from the common gas outlet.
- Turn the machine OFF.

6.8 Lighting

- When machine is turned ON, ensure that backlight is illuminated.
- Visually inspect the backlight and ensure that it does not have any marks and is evenly lit.
- Check that DA lights illuminate when a hand simulates turning the vaporizer knob.

6.9 Absorber

- Record the serial number on the check sheet.

Absorber Crossover Checks

- Turn the machine OFF.
- Fit corrugated hose between the inspiration and expiration ports.
- Fit a 2 litre bag to the absorber bag mount.
- Turn the absorber ON, to bag and turn the APL valve to its maximum position.

- Whilst watching the pressure on the absorber manometer, use the flush to fill the 2 litre bag on the bag mount, gas should be relieved through the APL valve at 40 to 50 cmH_2O.
- Squeeze the 2 litre bag, gas should be relieved through the APL valve at 60 to 70 cmH_2O.
- Turn the APL valve to its minimum position pausing to check for any leak, gas should be relieved steadily, the valve turn smoothly and the pressure should fall to 2 cmH_2O.
- Turn the APL valve to its maximum position then refill the 2 litre bag.
- Switch the absorber to vent, fill the bellows.
- Squeeze the 2 litre bag, ensuring that there is no 'crossover' between the two.

Absorber Removed Alarm Check

- Remove the absorber and ensure that the ventilator raises the appropriate alarm.

6.10 Ventilator

Power up

- Check all LED's illuminate and are aligned.
- Follow on screen instructions, ensuring absorber is switched off.
- Reconnect the system.
- Set running ventilator in CMV mode to a C20 test lung, at 0.50L TV 12 BPM and I:E of 1:2.0 with the pressure limit set above 50cmH_2O.
- Whilst allowing the system to warm up check the spirometry waveforms for regularity and ensure that the loops close.
- Record the bellows deflection, which should be 600 ± 80 ml, and (in the case of an 8700 only) compliance, which should be 100 ± 20 ml.

Volume Measurement

- Measure the delivered volume; this should be 50 ± 2ml, record this figure on the test sheet.
- Observe the monitored expired and (8700) inspired volumes.
- Ensure that these stabilise.
- Both should be within 2ml of the actual delivered volume.
- If it is necessary to adjust these readings then record old and new values of gain and ratio on the SR-CCR6.

Fresh Gas Calibration (8700 only)

- Calibrate the fresh gas measurement.
- Set 8lpm each of both oxygen and nitrous oxide, note the measured value which should be 16.0 ± 1.6lpm.
- Set 1lpm each of both oxygen and nitrous oxide, note the measured value which should be 2.0 ± 0.1lpm.

Fresh Gas Compensation

- Set 3lpm each of both oxygen and nitrous oxide, run ventilator with the parameters set above and note the bellows deviation, which should be reduced to 400 ± 80ml.

PEEP Test

- Restore basal flow set PEEP to 10 cmH_2O.
- Check that the minimum pressure and the monitored volume are stable.

Alarms

- Induce the following alarms and check that there are audible and visual indicators on the ventilator:

  High Pressure

  Mains Failure

  Supply Gas Failure

PCV Mode

- Remove additional fresh gas and PEEP.
- Set ventilator to PCV mode at 20 cmH_2O.
- Record monitored peak pressure, which should be stable and 20 ± 2 cmH_2O.

6.11 Checklist and Calibration Record

Ref.	Description	Valve	Units	Pass Criteria
	Visual Inspection		P/F	
6.2	Pipeline Leak test		P/F	<1/2 div. 3 mins
6.3	Suction Test		P/F	-500mmHg max
6.4	Scavenging System Test		P/F	Float Visible
6.5	Cylinder Leak Tests		P/F	<1/2 div. 3 mins
6.6	Hypoxic Guard		P/F	>21%
6.7	Switch/Anti-confusion/Oxygen Monitor/Oxygen		P/F	>8 secs
6.8	Lighting		P/F	
6.9	Absorber Serial No:			
	Crossover Checks		P/F	
	Absorber Removed Alarm		P/F	
6.10	Ventilator Serial No:			
	TV=0.5l, BPM=12, I:E Ratio=1:2.0, Absorber OFF		P/F	Loops Close
	Bellows Deflection		ml	600 ± 80ml
	Compliance		ml	120 ± 20ml
	Delivered Volume		ml	50 ± 2ml
	If adjusted	Gain		Ratio
	Old			
	New			
	Monitored Expired Volume		ml	Del ± 20 ml
	Monitored Inspired Volume (8700 only)		ml	Del ± 20 ml
	Set 16 lpm fresh gas, record monitored value		lpm	16.0 ± 1.6 lpm
	Set 2 lpm fresh gas, record monitored value		lpm	2.0 ± 0.1 lpm
	Bellows Deflection with 6 lpm fresh gas		ml	400 ± 80 ml
	Stable operation with 6 lpm fresh gas and 10cmH_2O		P/F	
	Peak Pressure in PCV mode, set 20 cm H_2O		cm	20 ± 2 cmH_2O
	Oxygen Monitor 50% set — Reference Unit — Monitored			
			P/F	Within 1% of ref
	atmosphere		P/F	Within 1% of ref
	Alarms-High Pressure, Mains Failure, Supply Gas Failure		P/F	
No. of Test Instruments used:				

Blease Frontline Sirius

Part No: **Serial No:** **Date:**

Works Order No: **Testers No:** **Signed:**

Checklist to be completed as applicable to each machine's specification.

7.0 Fitting Planned Maintenance Kits

Planned Maintenance

13600530

Figure 8 Sirius Annual Planned Maintenance Kit

Figure 8 Annual Planned Maintenance Part No. 13600530

1. **Bodocs Seals**
2. **Backbar Seals**
3. **Absorber Stop**
4. **Backbar Dzus Springs**
5. **AGSS Probe Seal**
6. **AGSS Float Seal**
7. **Pipeline Filter**
8. **Pipeline 'O' Ring**
9. **Bellows Base/Cover**
10. **Paed Bellows**
11. **Bellows Base/Pop off**
12. **Oxygen Sensor Probe**
13. **Absorber Upper Seal**
14. **Absorber 'O' Rings for Insp/Exp + APL**
15. **Pop off Valve**
16. **Oxygen Probe T-Piece**
17. **Absorber Gauge**
18. **Absorber Control Seal**
19. **Absorber Bottom Canister**

Planned Maintenance

13600531

Figure 9 Sirius 4 Year Planned Maintenance Kit

Figure 9 4 Year Planned Maintenance Part No. 13600531

20. Cylinder Regulator Service Kit

21. 'O' Ring for Filter

22. Battery

23. Filter

Notes

7.1 Removal/Replacement Instructions

When any repair or exchange is performed on internal components, a complete check must be made on all functions A complete overall performance check must also be performed when any replacements or repairs have been completed.

Removal of Outer Cases

Removal of top surface

Remove the 4 screws shown here (red circles are to indicate where screws are located) and lift the top cover off.

Remove bottom screw as shown

Remove top left screw as shown

Remove top right screw as shown

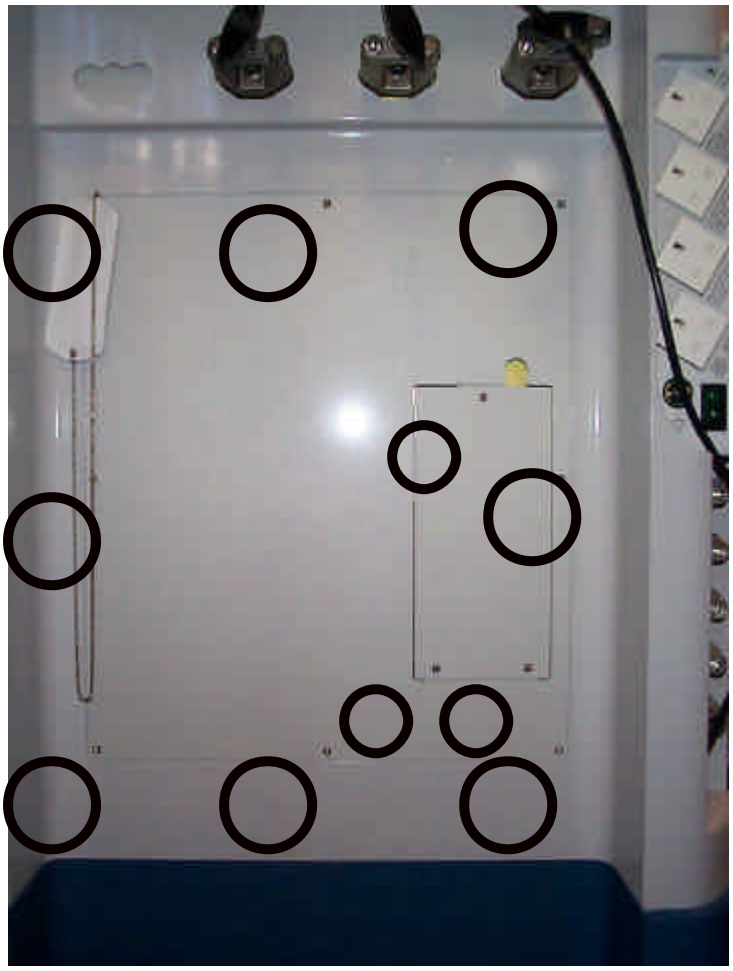
Ensure work surface is clear then slide front cover forwards in the direction shown.

Front of machine.

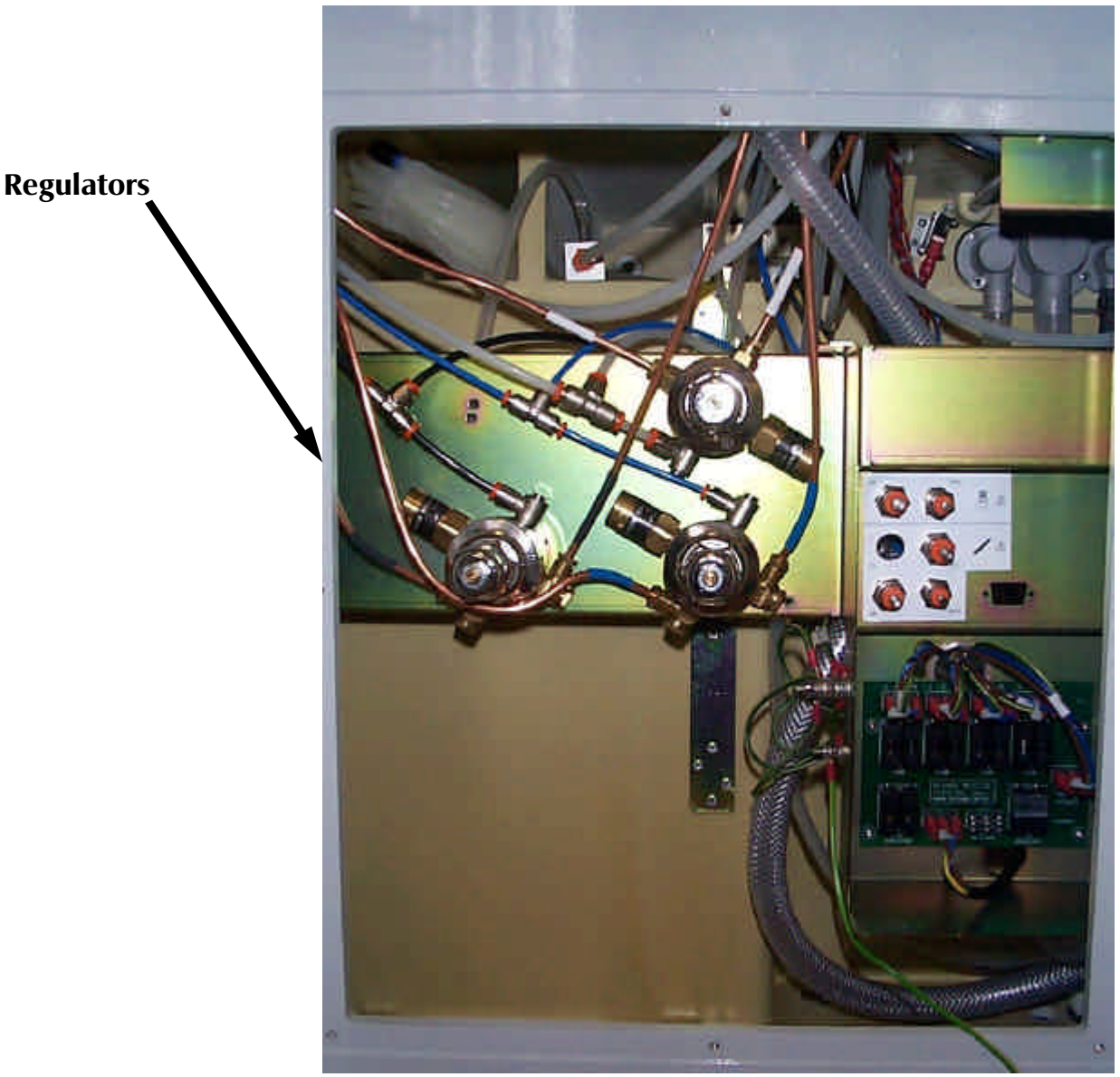

Manifold block
Flowmeter Filter location

(Not necessary for Routine Service)

Removal of back - Remove all pipelines and cylinders before removing screws



Remove small panel for partial access, remove larger panel for complete access.


Regulators

7.2 Fitting Planned Maintenance Kit 13600530

Bodoc Seals (1), Backbar Seals (2) and O2 Probe O Ring (3) are duplicated. The duplicated set is to be placed in one of the drawers for the user to replace if one is damaged or fails test during use.

7.3 Bodoc Seals (1)

- Remove cylinders from the yokes, then remove the old Bodoc Seal and replace with new ones.
- Refit the cylinder

7.4 Backbar Seals (2)

- Remove vaporizers from the Selectatec back bar then remove all four seals replace with new ones.

7.5 Backbar Dzus Springs (4)

- Remove the two Dzus Spring assemblies by undoing the two screws (in the diagonal corners of the plate). Lift the plate up taking care not to drop the index pin. The index pin must be fitted to the new Dzus Spring assembly before fitting the new item.
- After fitting use the Back Bar Test/Valve Test described earlier. (6.2.14)
- Refit the vaporizers

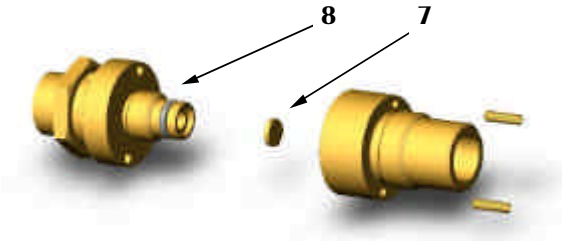
7.6 Absorber Stop/ 'O' Ring (3)

- Remove the 'O' Ring from the Absorber blanking plug and replace with new item.
- (new cell is supplied with 'O' Ring fitted).

7.7 Pipeline Fitting (7) and 'O' Ring (8)

- Disconnect pipelines from their supply. Disconnect the pipeline NISS/DISS connection from the Sirius.
- Unscrew the two small grub screws until the main body of NISS/DISS connection is free to rotate.
- Unscrew the connector, the filter and 'O' Ring can now be changed.
- Refit the outer part of the connector and tighten the two small grub screws.

- Repeat for all three pipelines.
- Note each gas type has a unique fitting and can not be incorrectly mixed.



Note On early production Sirius the NISS/DISS fitting can not be separated and the filter must be accessed from the rear which requires any monitoring to be removed then the top monitor shelf and rear cover to be removed.

Refit the pipeline and check for leaks. The anti-confusion Test should be carried out (6.2.6)

7.8 AGSS Probe (5) and Float (6)

- Disconnect electrical supply to Sirius. *3000 only*
- Remove the bellows assembly by sliding the absorber forward until the bellows connections become free, then remove the two thumbwheels at the front of the bellows. The bellows assembly can now be lifted clear of the locating pins at the rear of the bellows assembly.
- Working through the apparatus below the bellows assembly.

- (on 2000 & 1000 the AGSS unit is external).
- The AGSS probe can be pulled out of the top of the AGSS unit.
- Remove the 'O' Ring (5) and replace with the new part.
- Disconnect the 30mm connector from the side of the AGSS unit, (located approximately 100mm down the AGSS unit).
- The AGSS unit will now pull off its V mounting bracket and can be removed through the apparatus (on 3000).
- Hold the lower black part of the body (where the 30mm connector is) and unscrew the top black part (with the windows).
- Clean the filter.
- Remove the top 'O' Ring (6) slide the green float off the central stem and remove the bottom 'O' Ring (6).
- Replace the bottom 'O' Ring.
- Refit the float (make sure it is the correct way up) then replace the top 'O' Ring (6).
- Reassemble the fitted/window on top, screw onto the lower sections.
- Place the AGSS unit back onto its V bracket.
- Refit the 30mm connector and the AGSS probe.

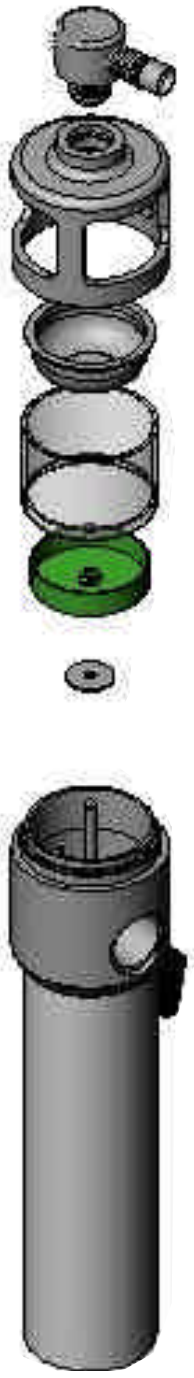


Figure 10 AGSS

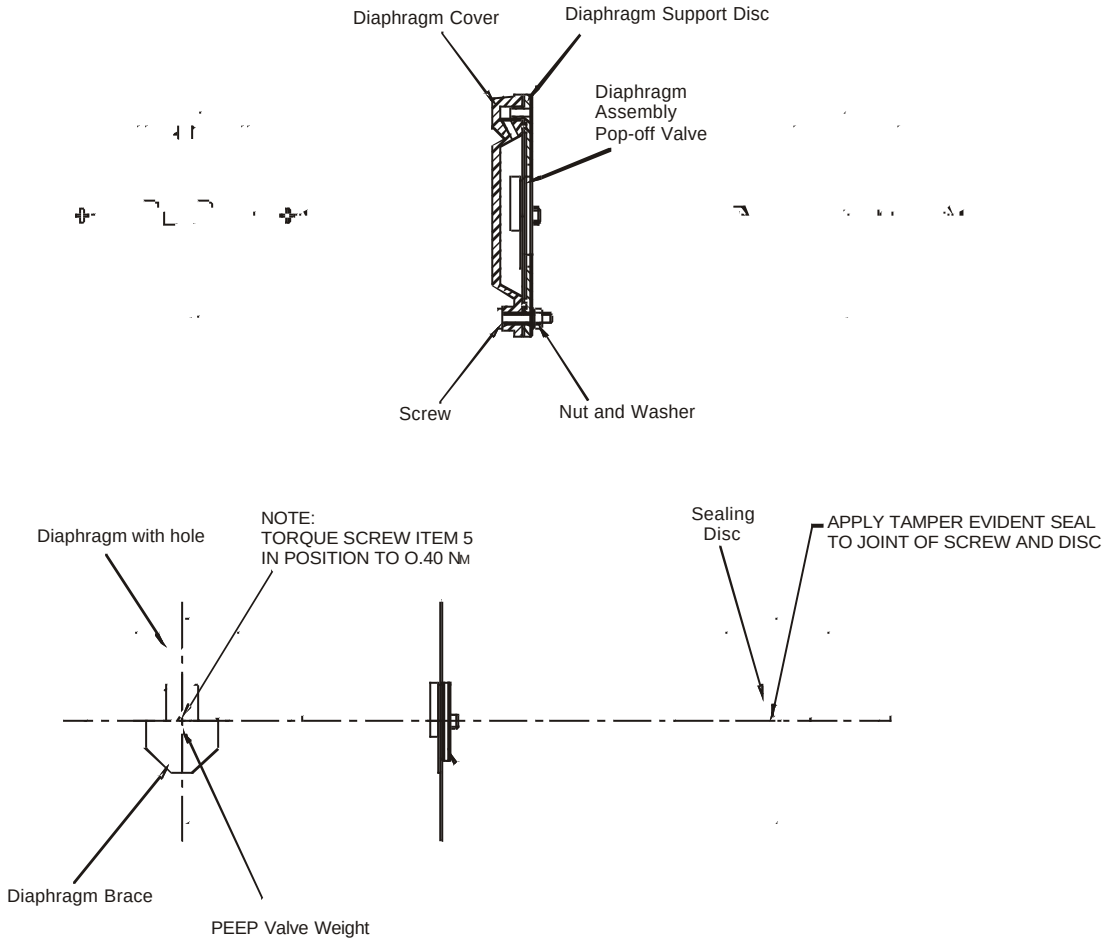
7.9 Bellows Base/Cover (9)

- Remove the bellows cover (bayonet fitting) and then replace the bellows base/cover 'O' Ring (9).
- Remove the bellows by gently pulling the lower convolution of the retaining ring.
- Remove the pop-off valve.
- Replace the white bellows base/pop-off (11)

7.10 Pop-off Valve (15)

- Undo the two screws that hold the pop-off valve cover and support ring together.
- Replace the diaphragm valve (15).

Figure 11 Pop-off Valve



- Replace Pop-off valve in bellows base.
- Refit bellows by gently pulling the lower convolution over the ring in the bellows base.
- Replace the bellows outer cover.

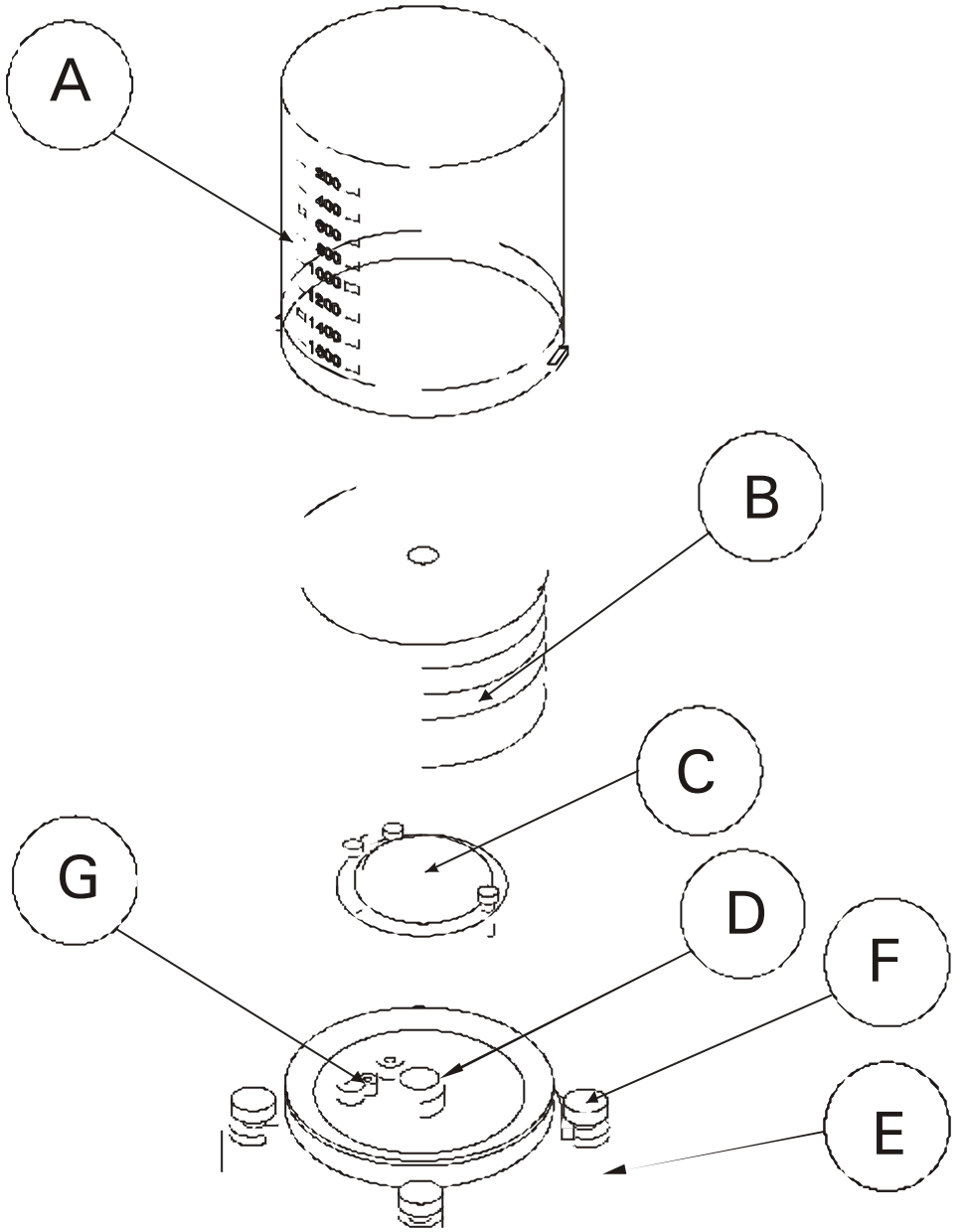


Figure 12 Bellows Assembly

- Check that the Pop-off valve does not leak by inverting the whole assembly, the block, 22mm inlet and turn the assembly until it is the correct way up.
- The bellows should not fall (it may drop 1-2cm but it should hold steady at that point).
- Refit bellows to the locating pins on the Sirius.
- Refit the fixing screws

7.11 Absorber

The absorber must have the soda lime removed and the unit cleaned before servicing.

7.11.1 Valve Covers

Note When removing or refitting any of these valves it is important to ensure the metal valve disk and seat are not damaged.

- Remove the PEEP valve by twisting the clear plastic valve cover.
- Replace the 'O' Ring seal (14) on the valve cover.
- Replace the PEEP valve on the absorber.
- Check the cable, from the PEEP valve to its connector under the work surface, is in good condition.
- Remove the inspiratory valve cover.
- Replace the 'O' ring seal (14) .
- Replace the valve cover.
- Remove the APL valve.
- Replace the 'O' ring seal (14).
- Replace the APL valve.

7.11.2 Manometer

- Remove the manometer gauge by pressing the quick release lever at the base of the gauge,
- Replace the 'O' ring seal (17).
- Refill the gauge.

7.11.3 Canister Seals

- The outer canister seal is a bayonet fitting.
- Turn the canister approx. 30° then pull down.
- The outer canister seal is located on the base of the absorber in the groove. •
- Replace the outer canister seal (19).
- The upper canister seal is fitted to a lip inside the bottom absorber moulding.
- Replace the upper seal (13).
- Make sure that the new seal is correctly positioned all the way round the lip.

- The central seal (18) is only used on 2kg systems where there are two canisters used.
- The central seal is simply laid on top of the lower inner canister before the upper canister is fitted.
- Replace the canister assembly onto the bottom of the Absorber.

7.12 Fitting 4 Year Planned Maintenance Kit 13600531

Parts 1 to 19 are the same as the annual kit. See the previous section on how to fit these.

7.12.1 Ventilator Filter (23) and 'O' Ring (21)

- Ensure all gas supplies are disconnected.
- See photos.7.1 for removal of top surface and front cover.
- Once the front cover is removed access to the 6 screw that hold the top of the ventilator casing closed will be possible.
- The front display panel will hinge forward a little this will allow the top cover to be hinged back.
- The filler cover is in the inlet manifold which can be seen from the front of the unit.
- Remove the cover.
- The filter is then able to be unscrewed.
- Replace the filter (23) and cover and make sure the new 'O' ring (21) is fitted.
- Replace the screws in the top cover and front display panel.
- Reconnect the O2 pipe-line only and turn the system on.
- Check that there are no leaks.
- Turn the systems OFF.
- Fit the front cover and top surface.

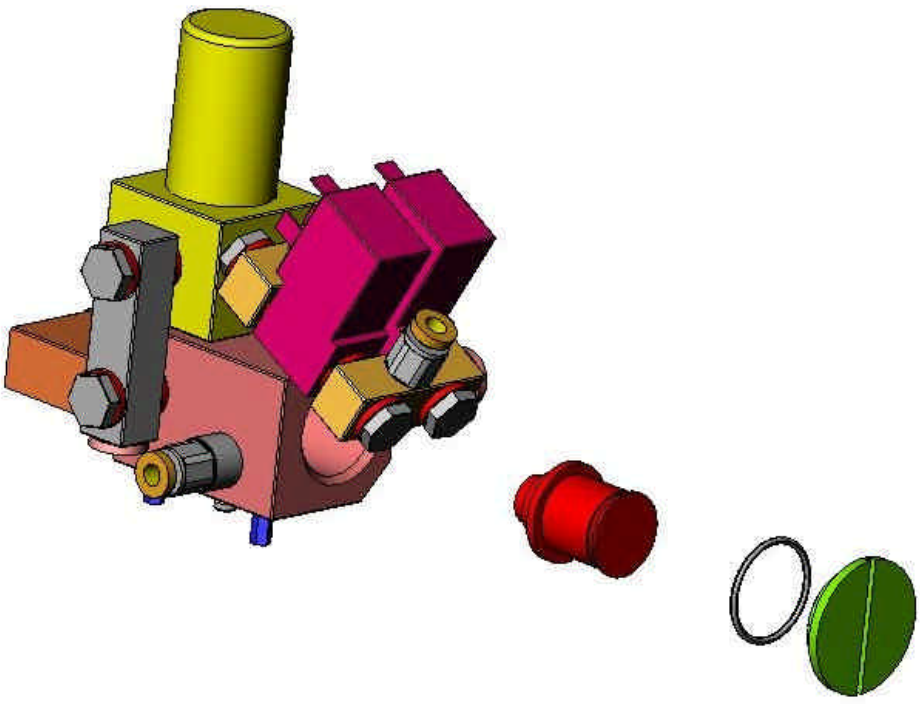


Figure 13 Pneumatic Module

7.12.2 Cylinder Regulator

- Remove all cylinders.
- Remove the large back panel (section 7.1).
- Fit a service kit to each of the regulators.

7.13 Servicing

Only authorised personnel should carry out servicing, and have the appropriate training and qualifications in the use of high-pressure medical devices. Servicing should take place in a clean and controlled environment taking particular care to prevent contaminants entering the unit whilst disassembled. The recommended service intervals are every 4 years. The following procedure outlines the steps taken to replace the parts included in the service kit 13600531:

DISSASEMBLY

1. Shut off inlet pressure. Reduce inlet and outlet lines to zero.
2. Turn adjusting screw anticlockwise using 1/8" A/F hex key to remove any spring load residual.
3. Remove bonnet by turning anti-clockwise using a 3/32" A/F spanner or socket. Retain upper spring rest, spring and slip ring.
4. Remove and discard the Diaphragm Assembly and the Actuator Assembly.
5. Remove and discard Valve Cartridge by turning anti-clockwise using a 17mm socket.
6. Remove and discard relief valve by turning anti-clockwise using a 15/16" spanner or socket.

ASSEMBLY

1. Fit new Valve Cartridge and Seal Ring. Torque to 16 ± 2 Nm.
2. Using tweezers or a small pair of pliers, remove Actuator Assembly from protective cap and insert it into the Valve Cartridge with the pin facing downwards.
3. Place the new Diaphragm Assembly over the Actuator Assembly and body. Check orientation is correct in relation to Fig 14.
4. Place the slip ring, spring and upper spring rest on top of the diaphragm assembly, taking care to ensure that position and orientation is correct (Fig.14)
5. Fasten Bonnet using a tightening torque of 27.5 ± 0.5 Nm.
6. Fit new relief valve and o-ring using a tightening torque of 25 ± 1 Nm.
7. Reset secondary pressure as required. See 'ADJUSTMENT'.

ADJUSTMENT

Turn adjusting screw clockwise to increase and counter-clockwise to decrease outlet pressure setting. To reduce pressure, first reduce to a pressure less than that desired, then increase to the desired outlet pressure. Turn adjusting screw using a 1/8" hex key.

Once 56 psi setting has been achieved, secure the locknut using torque if 6 ± 0.5 Nm.

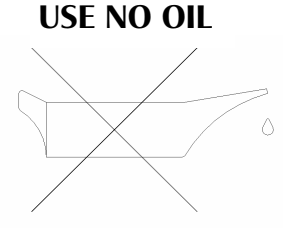
CLEANING

1. Cleaning of external surfaces is possible using water or isopropyl alcohol.
2. Cleaning of internal surfaces and parts should not be required and is not recommended.

WARNING

This product is intended for use in medical compressed gas systems only. Do not use this product where pressures and temperatures can exceed those listed under Technical data.

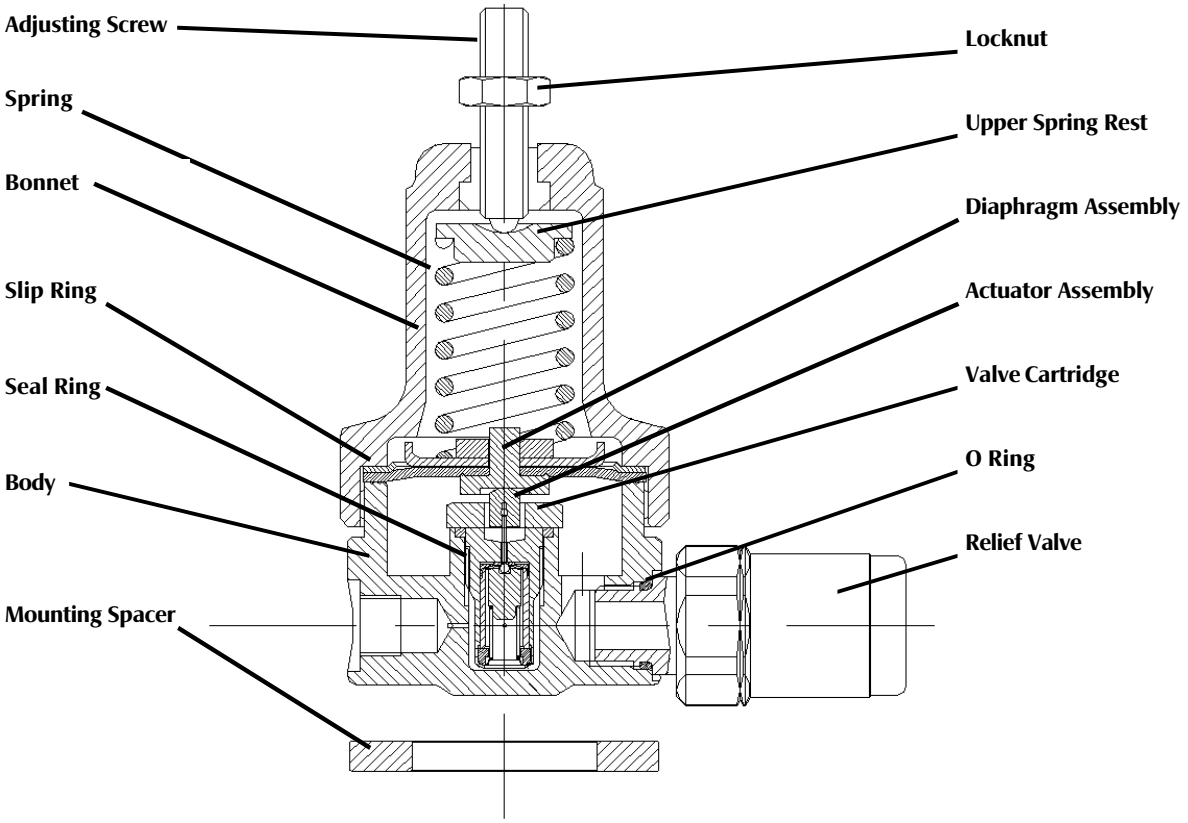
DO NOT use any lubricants that are not compatible with oxygen or medical gases. The use of lubricants not compatible with oxygen may pose a risk of fire or explosion.



Open the cylinder valve slowly to prevent the risk of fire or explosion due to oxygen pressure shocks.

The relief valve is a safety device and must only be removed for servicing. Once servicing is complete, a new relief valve must be fitted. Do not attempt to adjust or tamper with the relief valve.

Figure 14 Primary Regulator



Notes

8.0 Spare Parts

8.1 First Line Planned Maintenance Parts List

Flow Sensor	**10110218**
Flow Sensor Tubing	**1011090**
Manometer –10cmH_2O to 100cmH_2O	**54300032**
PEEP Valve 0cmH_2O to 20cmH_2O	**10300003**
Re-usable Soda Lime Canister	**12200221**
NRV Cover	**12200025**
NRV Disc	**12200162**
Outer Canister (2kg)	**12200228**
Bag Hook	**12200448**
Sirius 3000 work surface mat	**13600068**
Bellows Cover	**83035**
Bellows	**83034**
AGSS Filter	**12800034**
AGSS Float Window	**12800035**
Pipeline Protection Filter	**53700004**
Sirius Planned Maintenance Kit (Yearly)	**13600530**
Sirius Planned Maintenance Kit (Every 4 Years)	**13600531**
Oxygen Probe (single part)	**70300001**